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ECOSYSTEM FOR MONITORING, TREATMENT AND PREVENTION OF GENDER-BASED VIOLENCE

ECOSISTEMA PARA EL MONITOREO, TRATAMIENTO Y PREVENCIÓN DE VIOLENCIA DE GÉNERO

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Abstract: Violence against women is not a new phenomenon, nor are its consequences for women's physical, mental, sexual and reproductive health. What is new is the growing recognition that acts of violence against women are not isolated events, but form a pattern of behavior that violates their rights, limits their participation in society, and damages their health and well-being. In this research work we approached gender violence, seen from a holistic perspective, which allowed us to observe the treatment given by science in the resolution of this problem. Our contribution to this research work was the creation of a micro ecosystem that contemplates the creation of six (6) modules for the attention of victims, in which the affected individual, authorities, health providers, medical personnel, police authorities and neighbors were integrated. An unsupervised learning model, Hierarchical Cluster, was used to group the data. This clustering derived from the model allows the authorities to have an overview of how to segment the groups and employ preventive strategies for the problem of gender violence.

Keywords: Gender violence, ICT, Unsupervised learning, Artificial intelligence.

Resumen: La violencia contra las mujeres no es un fenómeno nuevo, ni sus consecuencias para la salud física, mental, sexual y reproductiva de las mujeres. Lo nuevo es el reconocimiento creciente de que los actos de violencia contra las mujeres no son eventos aislados, sino que forman un patrón de comportamiento que viola sus derechos, limita su participación en la sociedad y daña su salud y bienestar. En este trabajo de investigación se abordó la violencia de género, vista desde un panorama holístico, que permitió observar el tratamiento que le ha dado la ciencia en la resolución de este problema. Nuestra contribución a este trabajo de investigación fue la creación de un micro ecosistema que

contempla la creación de seis (6) módulos para la atención de las víctimas, en la cual se integró al individuo afectado, autoridades, proveedores de salud, personal médico, autoridades policiales y vecinos. Se empleó un modelo de aprendizaje no supervisado Clúster Jerárquico, para la agrupación de los datos. Esta agrupación derivadel modelo, permite a las autoridades tener una radiografía de como segmentar a los grupos y emplear estrategias preventivas para el problema de la violencia de género.

Palabras claves: Violencia de género, TIC, Aprendizaje no supervisado, Inteligencia artificial.

1. INTRODUCCIÓN

Violence against women is not a new phenomenon, nor are its consequences on women's physical, mental, sexual, and reproductive health. What is new is the growing recognition that acts of violence against women are not isolated events but rather form a pattern of behavior that violates their rights, limits their participation in society, and harms their health and well-being (World Health Organization, 2013).

Unfortunately, violence against women is just another form of violence within a much broader and more extensive universe of abuses, such as gender-based violence. Abuses against women based on specific circumstances are varied: rape as a weapon of war, acid attacks, honor killings, sex trafficking of women, female genital mutilation, forced marriage, etc. However, with the exception of rape in war, the most common perpetrator of these atrocities is someone known to the victim, usually a family member or acquaintance (Heise, 2011).

From this perspective, among the types of violence that undermine women's well-being is intimate partner violence or intimate partner violence íntima (IPV – Intimate Partner Violence). Intimate partner violence is the most common form of violence against women. At the population level, it far exceeds the prevalence of all other forms of abuse against women. Intimate partner violence is a human rights issue and a global public health problem of epidemic proportions. Approximately one-third of partnered women (30%) have experienced physical and/or sexual violence by an intimate partner at some point in their lives (World Health Organization, 2013).

Intimate partner violence typically refers to behavior within an intimate relationship that causes or has the potential to cause physical, sexual, or psychological harm, including acts of physical aggression, sexual coercion, psychological abuse, as well as controlling behaviors, isolation, and restriction of access to information and assistance (García-Moreno et al., 2015; Heise, L. & García-Moreno, C., 2002). Intimate partner violence occurs in all countries, cultures, and levels of society without exception, although some populations are at higher risk of partner violence than others (Sabri et al., 2019; Finneran, C., & Stephenson, R., 2013; Breiding et al., 2008; Heise, L., & Garcia-Moreno, C., 2002). While many men experience victimization in their intimate relationships, such violence is predominantly perpetrated by men against women (World Health Organization, 2013; Johnson, M. P., 2006).

Intimate partner violence is generally framed in relation to gender inequalities, especially in low- and middle-income countries where women may experience fewer social and economic opportunities compared to men. In these settings, women face limited political power, lower socioeconomic status, unequal access to education, fewer employment opportunities, and restrictive gender norms that promote male control, male sexual entitlement, and female subordination. These circumstances create and sustain the risk of IPV for women, particularly in low- and middle-income countries (Bourey et al., 2015).

Countries and global organizations have made efforts to reduce violence against women, dedicating extensive studies and research to determine the scope of violence against women and to understand the underlying causes and risk factors associated with violence and victimization (World Health Organization, 2013). There has also been significant growth in the number and scope of interventions in various settings, including healthcare systems, justice systems, and social campaigns, to address violence against women worldwide (Heise, 2011).

These interventions include mass campaigns, education-entertainment programs, skill development and economic empowerment, community mobilization, and participatory group education efforts. Their aim is to change attitudes and norms that support violence against women, empower women economically and socially, and promote non-violent and gender-equitable behavior (Heise, 2011). The first generation of interventions primarily focused on providing support services for victims of violence, reducing impunity for perpetrators, and improving the effectiveness of the justice system. A second generation of interventions, mainly in low- and middle-income countries, has placed greater emphasis on violence prevention (García-Moreno et al., 2015).

The design of effective IPV prevention programs involves identifying risk factors to appropriately adapt and target services. Given the complexity of violence against women and the studies aimed at understanding its origins or causes, abuse against women is conceptualized as a multifaceted phenomenon based on the interaction between personal, situational, and sociocultural factors. No single factor "causes" violence; rather, violence is more or less likely to occur as factors interact across different levels of the social ecology. The resulting paradigm became known as the social-ecological framework (Heise, 1998).

The social ecology includes the life histories, traumatic scars, and personality factors that men and women bring to their relationships, as well as the context and situational factors that affect their daily lives.

Ecological thinking (Heise, 2011) has represented an important step in the field of violence studies because it conceptualized the causes of violence as probabilistic rather than deterministic. In other words, the factors that operate at different levels combine to establish the likelihood of abuse occurring. No single factor is sufficient, or even necessary, for intimate partner violence to occur. There are likely different factors and pathways that can converge to cause abuse under different circumstances. Similarly, the same set of genetic, personal history, and situational factors may be enough to push a particular man toward intimate partner violence in one sociocultural and community context, but not in another. A man's response to "perceived" provocation may be quite different depending on his expectations regarding male/female relationships, and whether his friends, neighbors, and local authorities are likely to find his behavior "acceptable" or shameful. Several authors have attempted to identify factors that seem to be important for intimate partner violence at different levels of the ecological model. Following this, intervention strategies have been implemented in high-income countries as well as in low- and middle-income countries (Ellsberg et al., 2015).

Considering the social-ecological framework, there are various approaches to programs and interventions aimed at reducing violence against women and intimate partner violence. Structural interventions refer to public health interventions that promote health by altering the structural context within which health is produced and reproduced. Structural interventions address economic, physical, political-legal, or social environments that produce or reproduce the risk of IPV; in contrast, interventions that place the cause of the IPV problem on individual characteristics such as knowledge, attitudes, and behaviors are often referred to as person-centered interventions (Blankenship et al., 2006).

Structural interventions for the prevention of IPV can be classified as primary, secondary, and tertiary (Heise, 2011). Primary and secondary prevention interventions are defined as those aimed at preventing or reducing IPV, regardless of prior exposure to violence. While primary prevention aims to prevent initial IPV and secondary prevention seeks to prevent revictimization or recurrence, current epidemiological measures of IPV have limited sensitivity in measuring IPV patterns, and structural interventions address aspects of the environment that are likely to promote initial and sustained violence. Programs designed to screen women for intimate partner violence in healthcare settings and to conduct early identification of victims so they can be referred to support services are an example of secondary prevention (Heise, 2011).

Tertiary prevention strategies aim to prevent or mitigate the negative impact or social consequences among victims after IPV has already occurred (Bourey et al., 2015).

Despite growing global attention to intimate partner violence, the systematic evaluation of evidence for IPV prevention remains limited. This is particularly common in low- and middle-income countries (LMIC- Low- and Middle-Income Countries), where researchers often organize evidence through intervention strategies rather than comprehensive IPV models (Bourey et al., 2015).

Interventions to prevent IPV generally target one or more known risk factors for victimization or revictimization in isolation, but do not attempt to comprehensively address the complex socio-ecological risk factorss intervenciones para prevenir la IPV generalmente apuntan a uno o más factores de riesgo conocidos para la victimización o revictimización en forma aislada, pero no intentan abordar de manera integral los factores de riesgo socioecológicos complejos (Hackett, et al., 2016).
In addition to theoretical studies aimed at reducing the prevalence of IPV globally, efforts have also been made for this same purpose through technology. There are various ways in which technology can be used to address IPV, including: providing victims access to essential resources and healthcare providers; reducing feelings of isolation by allowing victims to stay in touch with their social networks and join online support groups; equipping victims with safety devices; helping to develop safety plans; recording and collecting evidence of abuse; empowering victims; and providing services related to health, housing, employment, and education, as well as financial and legal counseling (Al-Alosi, H., 2020).

The ability to access information instantly and at any time is one of the most important features of technology identified in existing research on IPV (Al-Alosi, H., 2020).

Specialized websites provide information on domestic violence, relationship self-assessment, details about services, safety planning, and referrals to local resources. Online self-help groups offer a source of information and support to victims who may not be ready to seek more formal services, as well as to former victims who are still dealing with the emotional aftermath of their experiences (Finn, J., & Atkinson, T. (2009).
The Internet provides mental health services that offer online therapy and counseling, enabling privacy and real-time access to appropriate resources for IPV-related populations (Glass et al., 2017; Hesser et al., 2017). Access to the Internet and web-based services facilitates mental health interventions and therapies for a wide range of individuals who otherwise would not have access to traditional face-to-face treatments (Hesser et al., 2017).

Just as web-based or electronic health (eHealth) provides an opportunity to reach a wide population of women and offer personalized and interactive interventions at no cost, any time of day, and without the stigma that may be associated with traditional face-to-face interventions (Koziol-McLain et al., 2018), the growth and evolution of technology have introduced new smart devices to deliver mobile services, giving rise to the paradigm of mobile health, mHealth.

Mobile health technologies (mHealth) are increasingly being used in health programs, including intimate partner violence (IPV) prevention, to optimize screening, educational outreach, and care linkage through telehealth (Cardoso et al., 2019). Various web-based and mHealth interventions have been proposed, including the provision of resources or health interventions via the web or mobile devices for the primary, secondary, and tertiary prevention of IPV victimization (Anderson et al., 2019).

Primary intervention can be more effectively disseminated among the target population through internet-based educational tools. Healthcare professionals and other providers may perform better in identifying individuals in need of IPV prevention services by conducting assessments with the help of technological tools, such as a computer or tablet, rather than using paper forms (Klevens et al., 2012).

Worldwide, technology-based applications and programs have been developed to reduce the prevalence of IPV. The use of smartphones to ensure women's safety against intimate partner violence has gained significant acceptance in many countries Sinha, et al., 2019), examples applications such as bSafe, Circle of 6, Women Empowerment y LifeCraft (Brathwaite, 2012; Jones, 2014; Mahmud et al., 2017; Khandoker et al., 2019). These smartphone-based applications allow users to send text messages to their registered emergency contacts along with their location using the Global Positioning System (GPS They employ quick mechanisms such as shaking the device or pressing a panic alarm or danger alert button. Some applications enable users to connect with nearby support services, such as pre-programmed hotline numbers, contact information for local police stations, hospitals, social networking sites, and other counseling services. Mobile applications also offer self-help learning/assessment services. These apps are designed to enhance users' understanding of violence, encouraging self-learning and self-assessment of their risk of abuse. Additionally, they can link users with support services, including legal,

economic, clinical, and social counseling (Sinha et al., 2019).

Regarding websites aimed at supporting women victims of IPV, several examples stand out. In Australia, the eSafetywomen website (2016) was developed with the primary goal of empowering Australian women to take control of their online experiences and helping them manage technological risks and abuse. The websites 1800RESPECT (2017) and IDECIDE (Hegarty et al., 2019; Tarzia et al., 2017; Tarzia et al., 2016) encourage victims to share their experiences and access information. In New Zealand, the isafe Project (Koziol-McLain et al., 2018), was created as an interactive web-based tool to assist with safety decision-making, aiming to improve mental health and reduce IPV exposure.

International organizations have also leveraged the use of the internet to increase victims' access to services and resources. In 2013, UN Women, UNICEF, and UN-Habitat launched a website and a smartphone application that provides information to victims of violence about available support services, including helpline numbers, access to legal assistance, and support services for women victims of violence. Comprehensive victim support systems have also been developed, such as mPOWERED (Mariscal et al., 2018), which enables healthcare providers in Africa to conduct assessments, enhance their knowledge about intimate partner violence, document injuries, and refer patients to specialists for treatment and follow-up care. The WONDER app (Barus et al., 2018) in Indonesia supports volunteers or police officers in handling victims of violence through prevention, rescue, protection, assistance, and consultation.

In Latin America, according to data from the Economic Commission for Latin America and the Caribbean (CEPAL, 2017) collected by the Gender Equality Observatory for Latin America and the Caribbean (OIG) over 2,700 women were murdered due to gender-based reasons in 2017. According to the data, the most common cause of these homicides was that they were committed by someone with whom the victim had or had had an intimate partner relationship, also known as intimate femicides.

According to the National Demographic and Health Survey by the Ministry of Health in Colombia regarding the violence women face in the family environment, extreme manifestations of physical and psychological violence are evident, deeply affecting women's quality of life, as well as their physical and emotional health in this country. According to the surveyed women, 31.9% reported having been victims of physical violence by their partner or ex-partner, with the most common form of aggression being pushing or shaking, accounting for 28%. The survey also reveals severe physical aggression, such as kicking or attempted strangulation. 8.7% have been kicked or dragged by their partner, and 4.4% have been victims of attempted strangulation or burns (ENDS, 2015).

To address this issue, the mobile application ELLAS was developed with the help of the national government and women's support organizations (ELLAS, 2017), his app allows women to recognize when they are victims of gender-based violence and provides guidance on the legal process they should follow. The application also has a web version on the site ellaslibresdeviolencias.com to expand channels and create new forms of outreach.

Taking into account the global and national reality regarding the issue of intimate partner violence (IPV), it is proposed to develop a platform for the prevention and treatment of IPV based on Information and Communication Technologies (ICT) to provide help/security services that reduce the risk of intimate partner violence in the city of Montería. The model incorporates a comprehensive care system for women victims of violence. The system consists of several modules: a training and education module, which will provide access to information related to intimate partner violence, empowerment, and gender equality; a clinical care module, which allows a health professional to conduct assessments to specifically detect intimate partner violence through questionnaires, history, location, symptoms, and physical injuries using appropriate clinical standards. It will also provide support to women victims of IPV with post-traumatic stress disorder (PTSD) through a PTSD symptom scale and a self-report questionnaire to evaluate the presence and intensity of recently occurring PTSD symptoms. Similarly, it is proposed to use accelerometer technology contained in Android devices to detect neurocognitive and physiological deficits resulting from injuries to the head, face, and neck.

By employing structured protocols and standardized assessments, the proposed system will assist healthcare professionals in identifying impairments or injuries caused by IPV and improving healthcare services for women victims of IPV. A third module, focused on resources, will provide contextualized

educational resources and reference materials for patients, offering training in appropriate detection and treatment methods to meet the needs of individuals affected by IPV in economic, legal, and counseling aspects specific to their context. These resources will guide women victims of intimate partner violence on financial, judicial, police, and social services available to them.

This research work proposes an ecosystem for monitoring, treating, and preventing gender-based violence. The document is organized as follows: related work, theoretical foundations, proposed model, results, and conclusions.

2. RELATED WORK

The following are some related works on the mentioned topic:

A Survey of the Mobile Phone-Based Interventions for Violence Prevention Among Women. Advances in Social Work, 19(2), 493-517.
This article provides a review, comparison, and classification of mobile phone-based violence intervention/prevention applications. First, it presents an overview and classification of violence prevention applications. Second, it discusses the evaluation metrics used to compare and contrast various violence prevention applications. Third, it provides a brief overview of how these applications work, their capabilities, limitations, and areas of focus. Fourth, it analyzes the features of well-performing applications and identifies areas for improvement. Finally, it concludes with the implications of these violence prevention applications for practical social work and future research.

Easton, C. J., Berbary, C. M., Crane, C. A. (2018). Avatar and technology assisted platforms in the treatment of co-occurring addiction and IPV among male offenders. Advances in Dual Diagnosis.
They present a preliminary study aimed at developing an interactive therapy platform that uses virtual avatars as therapy coaches to assist clients dealing with substance abuse and IPV. Preliminary results regarding patient satisfaction led to the development of additional avatars for use in interactive therapy.

Hegarty, K., Tarzia, L., Valpied, J., Murray, E., Humphreys, C., Taft, A. & Glass, N. (2019). An online healthy relationship tool and safety decision aid for women experiencing intimate partner violence.
This study evaluates whether an interactive online healthy relationship tool and safety decision aid (I-DECIDE) would increase women's self-efficacy and improve depressive symptoms compared to an informational website on intimate partner violence. The findings showed that women appeared to gain awareness, self-efficacy, and a sense of support from both the interactive I-DECIDE website and the static control website.

Tarzia, L., Valpied, J., Koziol-McLain, J., Glass, N., & Hegarty, K. (2017). Methodological and ethical challenges in a web-based randomized controlled trial of a domestic violence intervention.
This paper uses the case study of I-DECIDE, a web-based healthy relationship tool and safety decision aid for women experiencing domestic violence, developed in Australia. The I-DECIDE website was recently evaluated through a randomized controlled trial, and the paper describes some of the methodological and ethical challenges encountered during recruitment, retention, and assessment. It suggests that, with careful consideration of these issues, randomized controlled trials can be conducted safely online in this sensitive area.

Tarzia, L., Murray, E., Humphreys, C., Glass, N., Taft, A., Valpied, J., & Hegarty, K. (2016). I-DECIDE: an online intervention drawing on the psychosocial readiness model for women experiencing domestic violence.

This article describes the theoretical and conceptual development of I-DECIDE, an online healthy relationship tool and safety decision aid for women experiencing domestic violence (DV). It explores the use of the Psychosocial Readiness Model (PRM) as a theoretical framework for the intervention and evaluation.

The I-DECIDE website, currently being tested by researchers at the University of Melbourne, is based on the IRIS trial in the United States. Its goal is to help women who feel unsafe or fear their current or former partner develop a web-based safety plan.

Koziol-McLain, J., Vandal, A. C., Wilson, D., Nada-Raja, S., Dobbs, T., McLean, C. & Glass, N. (2018). Efficacy of a web-based safety decision aid for women experiencing intimate partner violence.
The aim of this study was to evaluate the effectiveness of a web-based safety decision aid

(iSafe) for women experiencing IPV in New Zealand.

Sabri, B., Njie-Carr, V. P., Messing, J. T., Glass, N., Brockie, T., Hanson, G. & Campbell, J. C. (2019). The weWomen and ourCircle randomized controlled trial protocol: A web-based intervention for immigrant, refugee and indigenous women with intimate partner violence experiences.
This article describes a study protocol to evaluate a culturally adapted, web-based safety/assistance planning intervention titled weWomen and ourCircle myPlan for immigrant, refugee, and indigenous (IMR) women in the United States. The goal is to assess the effectiveness of the intervention in reducing the future risk of abuse, intimate partner violence (IPV)/intimate partner homicide (IPH), and poor mental health among these women. El-Morr, C., & Layal, M. (2019, March). ICT-Based Interventions for Women Experiencing Intimate Partner Violence.

The objective of this systematic review is to summarize studies in different settings that have used Information and Communication Technologies (ICT) to address intimate partner violence (IPV). We conducted a systematic review following PRISMA guidelines using the following databases: PubMed, CINAHL, PsycINFO, and Web of Science. The inclusion criteria were ICT-based interventions addressing IPV, focused on women. Twenty-one studies were identified, showing that ICT is a suitable, low-cost option for IPV detection and disclosure, as well as for IPV prevention. Further research is needed to utilize ICT for the prevention and treatment of IPV, taking into account new ICT settings such as virtual communities.
Boduszek, D., Debowska, A., Jones, A. D., Ma, M., Smith, D., Willmott, D. & Kirkman, G. (2019). Prosocial video game as an intimate partner violence prevention tool among youth: A randomised controlled trial.
he objective of this article was to evaluate the effectiveness of a context-specific prosocial video game, *Jesse*, to increase affective and cognitive responsiveness (empathy) toward victims of intimate partner violence (IPV) among children and adolescents. The results suggest that Jesse is a promising new IPV prevention tool for both girls and boys, which can be used in educational settings.

S., Garduño, J., Zavala, R. I., Barindelli, F., Valades, J., Billowitz, M. & Marston, C. (2019). Preventing intimate partner violence among young people—a qualitative study examining the role of comprehensive sexuality education.

This document highlights some mechanisms through which comprehensive sex education programs with a gender-transformative approach appear to have supported the prevention and response to intimate partner violence (IPV) among youth in Mexico City within the programmatic timelines. The findings, which have implications for educational policy, emphasize the importance of schools as both sites of violence and for its prevention. In Mexico, where educational institutions may resist incorporating comprehensive sex education, these findings help demonstrate the importance of systematically implementing this type of intervention. The results suggest that this promising and relatively short-term comprehensive sex education program has scalability potential within Mexico's educational curriculum as a strategy to prevent and respond to IPV and potentially reduce homophobic discrimination or other forms of interpersonal violence common in school environments. We identified programmatic elements that appear to be more likely to provoke change among participants in Mexico City, which should be tested in other locations to see if they can have an impact on beliefs and practices related to IPV in other settings.

Cardoso, L. F., Sorenson, S. B., Webb, O., & Landers, S. (2019). Recent and emerging technologies: Implications for women's safetyThis exploratory study conducted a series of online searches to document and describe new technologies that can be used to improve or reduce the safety of women.

3. THEORETICAL FOUNDATIONS

The issue of intimate partner violence (IPV) has been the subject of public and academic attention in recent decades. IPV is recognized as a complex socio-cultural problem with epidemic proportions worldwide in public health (World Health Organization, 2013). Studies have been conducted to understand the underlying structural causes, risk factors, and consequences, in order to implement multisectoral services, programs, and responses that reduce its prevalence in society.

Intimate partner violence is defined as any behavior within an intimate relationship that causes physical, psychological, or sexual harm to the partner (Heise,

L. & Garcia-Moreno, 2002). Such behaviors include:
Acts of physical aggression such as slapping, kicking, and hitting.
Psychological abuse, such as intimidation, contempt, and constant humiliation.
Forced sexual relations and other forms of sexual coercion.
Various controlling behaviors such as isolating a person from their family and friends, monitoring their movements, and restricting access to information, financial resources, employment, education, or medical assistance.

Between the 1970s and 1980s, the understanding of intimate partner violence was initially based on theories and research from isolated disciplines such as psychology, sociology, and criminology, or the ideologies and political agendas of feminist activists.

Feminist theory emphasized the link between all acts of violence against women with the purpose of domination, to maintain the patriarchal structure of most societies. This ideology describes gender inequalities based on systems of oppression and power (Hooks, B., 1984).

Historically, frameworks for understanding the causes of IPV are divided into several categories (Kelly, U., 2011): (*a*) psychopathology theories (mental illness, substance abuse) of perpetrators and typologies of offenders, (*b*) psychopathology theories of victims, *(c)* biological theories of aggressive and violent behavior, (*d*) family systems theories, and *(e)* social learning theories. Each discipline examined the issue from its own field of knowledge, attempting to explain the phenomenon from a primary cause, but none of these theories fully explains why an individual perpetrates IPV (Schechter, S., 1982). For example, while social learning theory proposes that aggression toward an intimate partner is a learned behavior that can be passed down from generation to generation, not all children exposed to abusive parents become perpetrators.

Subsequently, the integration of studies from various disciplines led to more comprehensive and contemporary explanations of IPV, such as sociocultural models based on several traditional theories. Explanatory theories emerged that recognize the complex and multi-causal nature of the phenomenon, based on the interaction of personal, situational, and sociocultural factors, such as the social ecological model (Heise, L., 1998).
he ecological model is one of the most widely accepted and used conceptual theories that takes into account the interaction, multiplicity, and diversity of factors that determine intimate partner violence. The model was originally proposed by developmental psychologist Brofenbrenner (1979), adapted (Heise, L., 1998) and eventually adopted by the World Health Organization (García-Moreno, et al., 2005) and specifically in Colombia (López, et al., 2013), as a conceptual tool to address intimate partner violence. IPV is the result of a dynamic interaction between individual, relationship, community, and societal factors that influence an individual's risk of perpetrating or being a victim of violence. This model describes IPV as a multifaceted phenomenon that integrates all risk factors into four domains: individual, relational, community, and societal (Figure 1).

In the first domain, there are the personal histories of the women victims and their partners. On an individual level, the person who perpetrates or is a victim of abuse and violence has a set of biological traits, personality traits, and a personal history that shapes their behaviors and interactions with others. Individual factors associated with the perpetration of IPV include: (1) demographic factors such as age, education, and income, (2) witnessing domestic violence in childhood, (3) experiencing physical or sexual abuse as a child, and (4) substance use. A personal history of multiple interpersonal traumas, such as intimate partner violence, child abuse, and rape, is associated with post-traumatic stress disorder and other negative health outcomes for victims; therefore, cumulative trauma is an individual factor that influences the responses of women victims of IPV. These characteristics increase a woman's risk of experiencing IPV and influence their responses to intimate partner violence.

In the second domain or microsystem, there are the relationships among family members, such as close relationships with partners, family members, and peers, which can influence an individual's risk of perpetrating or being a victim of violence. Several aspects of the relationship level, especially in terms of family structure and functioning, have been identified as risk factors for the development of IPV. These include: (1) male economic and decision-making authority within the family, (2) male control over wealth and resources in the family, and (3)

marital conflict, particularly in relationships with asymmetric power structures.

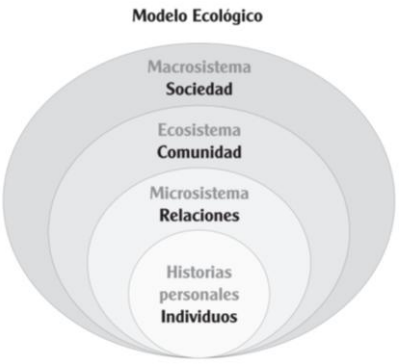
The third domain or ecosystem is made up of the social legitimizing roles of violence exercised by schools, family, neighborhoods, the media, the justice system, and socioeconomic contexts. Research has shown that communities with high levels of social disorganization, such as residential mobility, high population densities, and lack of cohesion among residents, are associated with higher levels of violence.

Community poverty, unemployment, and alcohol use have also been identified as risk factors for perpetrating violence, victimization from violence, or both. According to social disorganization theory, community-level poverty can be the source of much stress and conflict within intimate partnerships, so the influence of community poverty manifests at the relational level.

Finally, the fourth domain or macrosystem is the social acceptance of violence, the notions of family, and the roles socially assigned to its members. This includes broad social factors that create a climate that encourages or discourages violence within the community, relationships, and individual levels, including rules, norms, and social expectations that govern personal behavior and social inequalities between groups, such as patriarchal systems, oppression, poverty, sexism, and health disparities. For example, sources of support and formal assistance may not be available to socially marginalized women, making them vulnerable to gender-based violence and impacting their responses to violence.

This ecological approach to understanding violence integrates research findings from various disciplines into a comprehensive framework that enhances the understanding of the context, causes, and impact of IPV in women's lives, as well as the environment in which they are responding. The implications of the ecological model for IPV intervention are that strategies should be developed to target multiple levels, namely: individual, family, community, and social.

Fig. 1. The



ecological model of interpersonal violence (adapted from Heise, L., 1998)

Effective prevention strategies must be based on a deep understanding of the phenomenon, supported by high-quality research on the factors influencing violence and their interactions. Public health interventions are traditionally characterized in terms of three levels of prevention (Heise, L., & Garcia-Moreno, 2002):
Primary Prevention: Approaches aimed at preventing violence before it occurs.
Secondary Prevention: Approaches that focus on the immediate responses to violence, such as pre-hospital care, emergency services, or treatment for sexually transmitted infections after sexual abuse.
Tertiary Prevention: Approaches that focus on long-term care following violence, such as rehabilitation and reintegration, and attempts to decrease trauma or reduce long-term disability associated with violence.

Although these levels of prevention have traditionally been applied to victims of violence and in healthcare settings, they are also relevant for perpetrators of violence and have been used to characterize judicial responses to violence.

To reduce the level of intimate partner violence in a population, primary prevention initiatives must be implemented to create a generation of men, women, children, leaders, and social institutions that view family violence as unacceptable and are willing to take action to stop it. These strategies aim to reduce the rate of intimate partner violence at the community level and prevent violence before it starts. This contrasts with secondary prevention, which focuses on reducing the rate of repeated violence among women who have already been abused. The final category, tertiary prevention, is necessary to mitigate the negative impacts of violence that has already occurred (Heise, L., 2011).

The theoretical development related to IPV in recent decades has coincided with and driven some of the social and cultural changes regarding violence against women; with broad public recognition of the problem and recognition within health sciences and disciplines that intimate partner violence is a public health epidemic, requiring resource commitment for prevention and intervention. However, despite this growing momentum among health scientists, doctors, and society in general, few effective interventions have been developed to prevent IPV, adequately respond to IPV survivors, and mitigate its harmful effects on women (Bourey, C., et al., 2015). This is likely due to an overly simplistic understanding and approach to the problem, rather than a multidimensional one.

4. PROPOSED MODEL

The proposed model is supported by (Heise, L., 1998). To address the different areas of the gender-based violence ecosystem, six (6) micro-ecosystems have been proposed, providing dynamic information that includes the participation of the individual, family, community (neighbors), and social aspects, as shown in Figure 2.

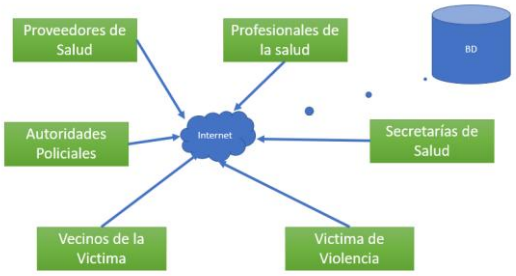


Fig. 2. Ecological model for addressing violence.

The modules contemplated in this ecosystem are designed to work synergistically through the exchange of information for the care of violence victims. Below, each module and its function in the system will be described.

- **Healthcare Providers**: This module involves the acquisition and management of data from violence victims. The collected information can be modeled using machine learning algorithms, which can be either supervised or unsupervised, for decision-making. Additionally, it provides mechanisms to implement strategies for designing preventive measures for vulnerable groups identified in artificial intelligence models.

- **Police Authorities:** This module allows access for tracking and assisting violence victims, responding to alerts activated by the victims' module. It also enables traceability of incidents reported by abused individuals and generates records for legal cases.

- **Neighbors of the Victims:** This module allows the management of reports made by neighbors regarding suspected violence in close proximity to the victims. The system facilitates handling the report, including geolocation and description of the situation. This information is automatically sent to the Health Department and Police Authorities modules for immediate response to the case in question.

Victim of Violence: This module is designed for the person involved in an assault to activate the panic button and describe with keywords the type of violence they are experiencing. The module will be able to send the victim's location along with the description of the assault to the Police Authorities and Health Department modules.

- **Health Departments:** This module allows access to information about victims of gender-based violence and receives real-time alarms generated by the assaulted individuals. In this way, the information is sent to the police authorities for them to respond to the case. Additionally, it enables the management of victim data to generate mechanisms for early intervention. It also allows the creation of preventive strategies, similar to the Health Providers module, for designing awareness campaigns targeting vulnerable populations. Like the Health Providers module, artificial intelligence models are used to generate clusters that help focus prevention campaigns.

- **Health Professionals:** This module provides medical and psychological assistance to victims of gender-based violence. It manages the information of the assaulted individuals and systematizes treatments based on the type of aggression presented by each individual.

Finally, there is a centralized persistence unit that allows the storage of the different modules of the ecosystem. This unit is accessed remotely by each of the modules and is available online in real-time.

5. RESULTS

For demonstration purposes of this research work, the Health Secretary module was used as a reference. One of the sections of this module involves the processing of data from victims of gender-based violence. For the persistence unit, the open database of Gender and Domestic Violence from January 2015 to March 2023 - Epidemiological Week, from the Santander department in the city of Bucaramanga, was used as a reference. The header of the obtained data is described in Table 1.

Table 1: Description of Open Data on Gender Violence in Bucaramanga

FIELD	DESCRIPTION
Order	Consecutive auto-number
Department	Name of the Department where the patient resides at the time of notification
Municipality	Name of the municipality where the patient resides at the time of notification
week	Corresponds to the distribution of the year into 52 epidemiological weeks
year	The year in which the event occurred
Age group	Age of the referred person
Life cycle	Age classification of the patient according to the Ministry of Health and Social Protection: 00. NO REPORT, 01. Early Childhood, 02. Childhood, 03. Adolescence, 04. Young Adults, 05. Adulthood, 06. Older Adult
Gender_	Physiological characteristics of the patient, which are: MALE, FEMALE, No Information
area_	Neighborhood where the treated patient lives
Neighborhood	Political and administrative distribution of the municipality for grouping neighborhoods
Commune	Name of the commune
Type of Social Security	Refers to the affiliation regime in the general health social security system in which the case being notified or its caregiver is enrolled
patient type_	Type of patient
alive/dead_	Refers to the condition of alive or deceased upon discharge from the healthcare institution
version	Version of the events that generated the violence
nature	Any violent action or behavior developed based on power relations related to gender
Nature definition	Any violent action or behavior developed based on power relations related to gender
activity	Activity the victim is engaged in
Activity name	Activity the victim is engaged in
Attacker Age	Age of the aggressor
Attaker gender	Gender of the aggressor
relationship with victim	Relationship between the aggressor and the victim
substance in Victim	Presence of alcohol or other substances in the victim
event date	Date of occurrence of the event
event time	Time of occurrence of the event
scene	Scene where the event occurred
Exposure Zone	The site where the victim was likely exposed to violence; the time of the nature should be considered to determine the exposure location
event name	Name of the type of violence
public health entity	Public or private entity that captures public health events and generates useful and necessary information for the Public Health Surveillance System
victim's department	Department of residence of the victim
victim's municipality	Municipality of residence of the victim
MONTH	Month in which the event occurred

Source: Secretariat of Health and Environmental Affairs - Bucaramanga[1]

To conduct the data analysis, the unsupervised learning model Hierarchical Clustering (Clúster Jerárquico) was used. The following fields were utilized: sust_vict_, nature (naturaleza), relationship_with_victim (parentezco_vict), and scene (escenario).

Running the model, it was observed that the dendrogram generated 9 clusters based on the obtained data. This algorithm groups victims of gender-based violence according to the established parameters such as: the nature of the violence, the substance consumed by the victim, the relationship of the aggressor, and the scene where the act of violence took place, as shown in Figure 3

[1] https://www.datos.gov.co/en/Salud-y-Protecci-n-Social/04-Violencia-de-G-nero-e-intrafamiliar-de-enero-20/sq8q-pnf5

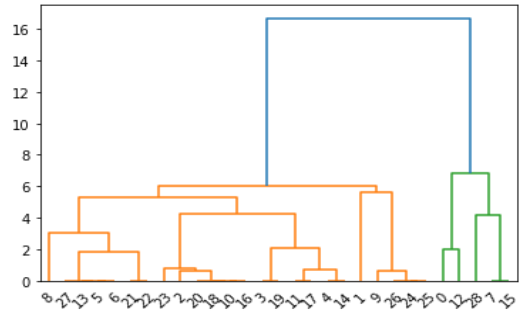


Fig. 3. Clusters generated of victims of gender-based violence.

As mentioned in the previous section, this module allows for the generation of these types of groupings, so that authorities, health providers, and professionals can develop strategies to reach each segment of vulnerable groups. This includes generating preventive campaigns to avoid gender-based violence in the targeted groups. This tool can be very useful for the care of the population that is intended to be served.

Another application example can be seen in Figure 4, where the scenes of the events are visualized, according to the nature of the violence, the relationship of the aggressor, and the presence of substances in the victim. This information can also be used for segmenting the population to which preventive strategies are intended to be directed.

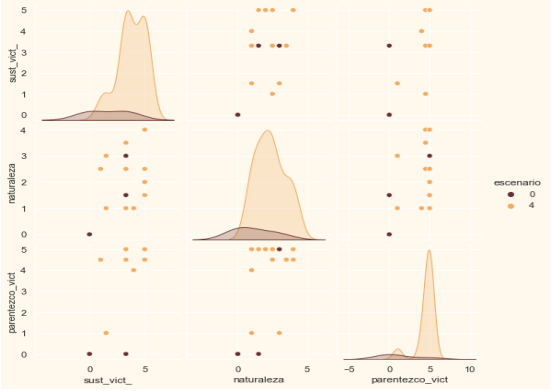


Fig. 4. Clusters by characteristics

6. CONCLUSIONS

Gender violence is a persistent issue in today's society. It is not only a concern for developing countries, but also a common practice in developed ones. It is evident that with the advent of information and communication technologies, new tools have emerged that help victims of violence better address this issue. However, despite the existence of applications and studies related to gender-based violence, abuse rates continue to persist worldwide, including in our country.

This research paper addressed gender-based violence from a holistic perspective, which allowed for an observation of the approach taken by science in addressing this issue. Our contribution to this research was the creation of a micro-ecosystem that includes the development of six (6) modules for victim support, integrating the affected individual, authorities, health providers, medical personnel, police authorities, and neighbors.

Finally, a health department module was developed for processing data from victims, and an unsupervised learning model, Hierarchical Clustering, was employed for data grouping. This grouping, derived from the model, allows authorities to have an overview of how to segment the groups and implement preventive strategies for the issue of gender-based violence.

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