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ORIGINAL ARTICLES AND REVIEWS

# EpiWEAT: a new digital assessment tool for epigenetic studies

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**Abstract**

***Introduction.*** Intimate partner violence (IPV) profoundly impacts women's health, increasing the risk of chronic and non-communicable diseases. Recent findings underscore the promise of epigenetic indicators to uncover the enduring effects of trauma on the human genome, especially concerning stress-related conditions such as post-traumatic stress disorder (PTSD).

***Objectives.*** To evaluate the lasting health impacts of violence against women, developing a digital tool specifically structured to consolidate crucial details about the contexts of violence, the relationship between victim and perpetrator, and health outcomes.

***Methods.*** A Microsoft Forms-based questionnaire was developed, organized into nine sections addressing socio-personal information, external conditions of violence, health statuses, and psychological evaluations, incorporating PTSD assessment via the International Trauma Questionnaire and depression measurement through the Center for epidemiologic studies depression scale revised (CESD-R) module. Data is securely archived, and participation includes optional consent for epigenetic analysis through blood samples.

***Conclusions.*** The assessment tool presents a thorough tool for gathering information on IPV, evaluating health outcomes, and identifying PTSD and depression in survivors. It also aids in the collection of biological specimens for epigenetic exploration. This instrument could enhance intervention strategies and contribute to precision medicine methodologies, facilitating early detection of chronic health risks in women who have experienced violence.

**Key words**

- intimate partner violence
- epigenomics
- patient health questionnaire

## INTRODUCTION

Violence against women is an important public health problem that represents violations of human rights and can have serious and directed consequences on the onset of noncommunicable diseases. There is now an increased understanding at the international and regional levels that health is not just an issue of development, but primarily a matter of human rights.

Intimate partner violence (IPV), i.e., violence by a partner or in the family or relationships, is the most common form of abuse. It is estimated that about 27% of women aged 15-49 years worldwide have experienced physical and/or sexual IPV in their lifetime, with large differences ranging from 16% in Southern Europe to as high as 51% in Melanesia. Overall, 13% on average have been subjected to physical and/or sexual IPV at some point within the past 12 months, with proportions ranging from 4% in Australia and New Zealand to 32% in Central sub-Saharan Africa [1].

According to research by Italian National Institute

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of Statistics (Istituto Nazionale di Statistica, ISTAT), 6 million 788 thousand women between 16 and 70 years of age in Italy have experienced some form of physical or sexual violence in their lifetime. In particular, 1,157 million involved the most serious forms of sexual violence such as rape (652 thousand) and attempted rape (746 thousand). An estimated 2,151,000 women between the ages of 16 and 70 have experienced persecutory behaviors by an ex-partner in their lifetime [2].

According to the European Injury Database (EU-IDB) [3], collecting data on the external circumstances of accidents compliant with the World Health Organization (WHO) guidelines on injury surveillance [4], the three most common forms of violence against women are: IPV (39% of cases of violence against women), violence committed by an acquaintance or friend (17%) and violence committed by a stranger (17%). In the 2021-2022 time span EU-IDB data shows that when the victim of violence is a woman, in 77% of cases the perpetrator is a man, aged 25-64 years. Fifty-five % of women victims of violence perpetrated by a man are aged 34 years or younger (*Figure 1*).

The consequences of violence on women's health can be physical and psychological. In particular, the health effects on women assume different levels of severity starting from fatal outcomes (e.g., femicide or termination of pregnancy), up to conditions of physical morbidity (mainly consequences of trauma, burns, poisoning or intoxication) and psychological problems with health conditions which include post-traumatic stress disorder (PTSD) [5], depression, substance abuse and self-harm or suicidal behavior, eating disorders, sexual disorders, etc. [6-10].

Recent scientific literature has shown how environmental factors, including violence, can alter the structure and functionality of our genome [11, 12]. Violence, and in particular intimate partner violence, is to be considered as an environmental factor "extremely negative", which significantly affects the expression of our genome and leaving traces in the DNA. Studying the epigenetic markers represents an innovative approach to understanding the effects of violence on the psycho-physical health of women. Epigenetic marker identification could indicate a connection with novel pathways that are yet to be associated with the risk of other non-communicable diseases.

Moreover, epigenetic information in parallel with psychological evaluation could create an innovative therapeutic protocol tool that takes gender differences into account and is based on precision medicine. To demonstrate the biological correlation between violence and the onset of chronic, disabling and non-communicable diseases, it is mandatory to invest in longitudinal studies where prospective data are associated with the epigenetic signature of women's DNAs. Due to the long-term effects being felt later in life, there is a threat of being seen as independent and unconnected to the violence endured.

Previous research has shown that three genes related to PTSD exhibit changes in DNA and are found to be hyper-methylated in women who have experienced violence. These changes relating to the three genes consisted of a higher degree of DNA methylation in women who had suffered violence compared to women who had not suffered violence. These epigenetic modifications in association with psychological assessment, could offer a new tool to identify innovative therapeutic protocols based on precision medicine, which, considering molecular damage association, can help prevent long-term health effects [13].

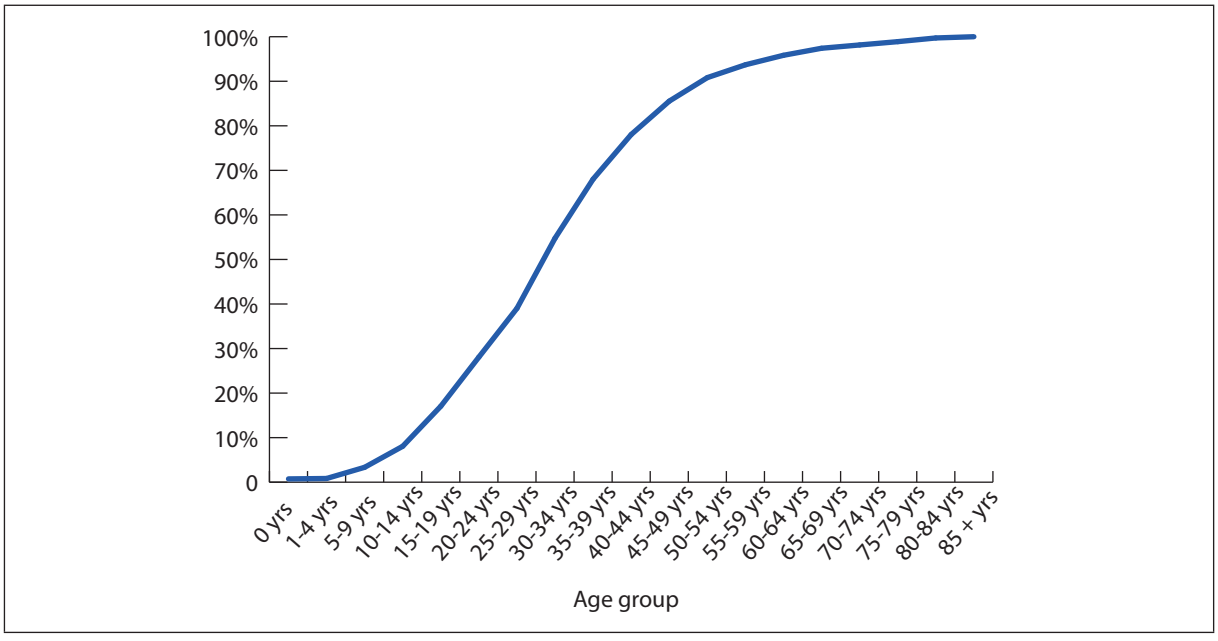


**Figure 1**
Admissions to Emergency Departments of women who have experienced violence. Cumulative percentage distribution by age. Source: European Injury Database.

Suffering violence represents one of the components of that causal process that leads to the onset of chronic and non-communicable pathologies. In fact, the prolonged stress caused by gender violence leads to an activation of allostatic systems with serious consequences on health. Understanding and identifying the epigenetic modifications that arise following the violence suffered is important precisely because of their reversibility. Epigenetics represents the molecular mechanism capable of connecting society to biology, the human and social sciences to the life sciences.

In order to learn more about the long-term health effects of violence against women, the Italian Ministry of Health has funded a multicenter, transdisciplinary project, "Violence against women: long-term health effects for precision prevention". This research, which adopts a transdisciplinary approach, aims to propose a series of innovative and interconnected strategies designed to ensure long-term support for women who have experienced violence. These strategies focus on the early detection of chronic, non-communicable diseases that may stem from the trauma they have endured.

One of the research lines of this project is to integrate the national guidelines [14] with a tool that allows the detection of multiple aspects of interest for the purposes of characterizing the violent event: from the context of the aggression to the victim-aggressor relationship, from the risk of recidivism to the evaluation of post-traumatic stress disorder (PTSD). This assessment tool aimed at improving innovative approaches and limiting the effect long-term impact of violence on women's health is a questionnaire developed in Microsoft Forms which is made up of 9 sections, each of them dedicated to exploring specific issues.

The purpose of this Brief Note is to illustrate and describe the digital questionnaire realized as a deliverable of the project (*see Supplementary Material available online*).

## DEVELOPMENT of EpiWE ASSESSMENT TOOL (EpiWEAT)

The use of an electronic questionnaire to collect data on violence against women plays a pivotal role in developing an effective local support model. By standardizing and centralizing the data, it ensures thorough assessments and enhances coordination among healthcare providers, law enforcement, and social services. Moreover, the data collected is essential for interpreting epigenetic results, as it provides context for biological processes influenced by environmental, lifestyle, and health factors. Without accounting for these variables, epigenetic findings may be misinterpreted.

The proposed model seeks to establish a comprehensive territorial approach to long-term care for women, based on the principles of precision medicine. The EpiWE assessment tool (EpiWEAT), aims to centralize all relevant information about the violence experienced by the woman into a single evaluation tool. This tool will support health and social services in offering the most appropriate assistance while also identifying early indicators of potential chronic conditions. The questionnaire will gather data about the context of the attack, the relationship between the victim and the perpetrator, the aggressor's age group, the risk of recidivism, and the presence of depression and PTSD in women victims of violence.

The questionnaire – currently developed in Italian but adaptations into other languages by native speakers are in progress – is organized into 9 sections (*Figure 2*).

Each section is independent of the others and the woman can stop answering the questions at the end of each section in case she doesn't feel comfortable in proceeding. More in detail, the questionnaire is structured as follows:

- *Section 1* includes the data collection phase, facility identification code, patient identification code;
- *Section 2* contains the "Socio-personal data" (patient's level of education, relationship with current partner, patient's occupation, citizenship or foreign country of birth of the patient, number of cohabiting minor children, number of cohabiting children with disabilities, number of minor children from another partner);
- *Section 3* consists of the "External circumstances of the violence" (victim-aggressor relationship, sex of the aggressor, age class of the aggressor, type of event whether single or repeated, type of violence suffered and when it occurred, type of violence suffered and for how long suffers it, assessment of the severity of the violence);
- *Section 4* evaluates the re-victimization risk through the "Severe recidivism risk assessment (danger assessment, DA-5)" [15];
- *Section 5* includes "Chronic diseases and conditions, signs and symptoms" information (eating disorders, uro-gynecological disorder, sexual dysfunction, gastrointestinal pathology, sequelae or complications of trauma, burn or poisoning, motor, sensory or functional disability, other pathology, sign or symptom);
- *Section 6* comprises "Taking of drugs" (indicate which drug(s) you take);
- *Section 7* consists of information about "Psychiatric/psychological therapy or consultancy" (psychiatric/psychological therapy or consultancy, taking antidepressants or anxiolytics, if following a path with a psychotherapist, if following a path with a psychiatrist);
- *Section 8* includes the ITQ-International Trauma Questionnaire (assessment of PTSD using the ITQ Italian version) [16] to evaluate the PTSD presence;
- *Section 9* contains the "Depression Assessment" (assessment of depression using the Center for epidemiologic studies depression scale revised (CESD-R) abbreviated depression scale; https://cesd-r.com/about-cesdr/).

At the end of the questionnaire, the woman is given the opportunity to express her willingness to join or not to join the epigenetic study, which will include the donation of a blood sample.

A closed-ended response structure was chosen primarily because the predefined options reduce the cognitive load on the women interviewed, thus increasing the response rate. In addition, data analysis is also simplified, as responses can be easily coded and processed in an automated manner, allowing for faster and more accurate statistical analysis. Another advantage is the consistency and comparability of the data, as all

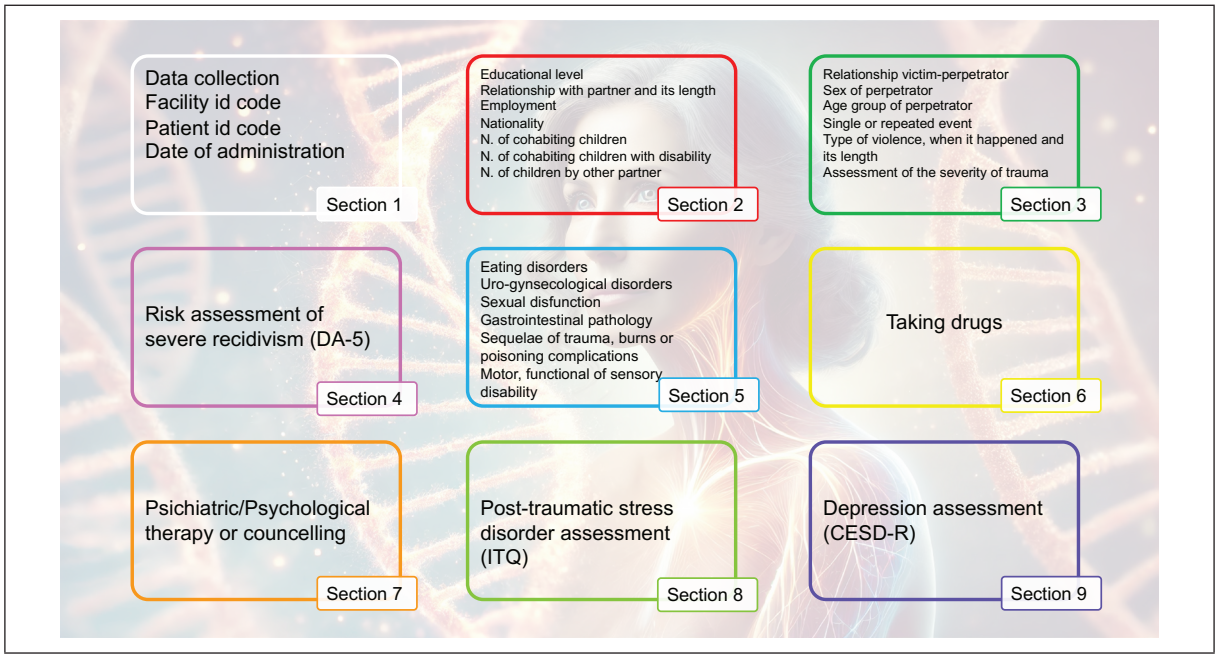


**Figure 2**
Epigenetics for Women Assessment Tool (EpiWEAT): diagram illustrating the structure of the questionnaire and its sections. The image in the background was created using a prompt generated with ChatGPT.
DA-5: danger assessment-5; ITQ: International Trauma Questionnaire; CESD-R: Center for epidemiologic studies depression scale revised.

women respond in a standardized manner, eliminating ambiguities and facilitating the comparison of results. Lastly, closed-ended answers also reduce the interpretation bias, offering more objective results and reducing subjective influence during data analysis. This format allows for targeted information, preventing vague or irrelevant answers, especially on sensitive topics.

Data are collected with Microsoft Forms and stored in the Microsoft cloud tenant dedicated to ISS, in full compliance with the General Data Protection Regulation (GDPR) rules. Results from the questionnaire will be accessible exclusively to the epidemiological staff of the Environment and Health Department of Italian National Institute of Health (Istituto Superiore di Sanità – ISS) involved in the project.

The assessment tool will allow greater collection of information on the circumstances of the violent event which, together with psychological assessments, will be the real assessment and prevalence tool of complex PTSD and PTSD. Furthermore, the collection of biological samples, for future studies of the epigenome, will allow the creation of a network of information and research.

The questionnaire will be accessed from any device connected to the Internet, including computers, tablets and smartphones, through a link generated directly by the application. The link will be sent to the heads of the project's operational units, who will oversee identifying the professionals (doctors/psychologists) who will manage the questionnaire's administration, after signing the informed consent.

The topic of violence is very sensitive and can evoke strong emotions or traumatic memories in respondents. When filling out a self-administered questionnaire, there is no immediate support available for the person who may be overwhelmed by intense emotions or discomfort. For this reason, the administration of the questionnaire will be conducted by a professional, who may be able to provide immediate psychological support if signs of stress or trauma emerge. The questionnaire can initially be administered when the woman is admitted to the Emergency Room, provided she is able and willing to complete it at that time. If she is unable to complete it during admission due to medical or emotional reasons, it may be administered later, for instance, during the first follow-up visit scheduled a few days after admission. This approach ensures flexibility in the timing, allowing for a sensitive and supportive process that respects the patient's physical and emotional state.

From tests with a convenience sample, the questionnaire proved to be an easy assessment tool to administer, with comprehensible questions and a duration compatible with stressful situations. The complete compilation takes an average of 20 minutes, but the possibility of stopping the administration at the end of each section and resuming it later minimizes the emotional impact on the woman victim of violence.

This questionnaire will be administered by a professional, such as a psychologist, for several important reasons related to the sensitivity of the topic and the need to ensure the well-being of the person involved. First, violence is an extremely delicate issue that can trigger strong emotions, including fear, anxiety, shame, or guilt. A professional can provide immediate emotional support and promptly intervening if the woman shows signs

of distress or suffering during the questionnaire. This helps prevent the person from feeling overwhelmed or abandoned while dealing with traumatic memories.

Furthermore, a professional can create a safe and protected environment, fostering a relationship of trust where the woman feels free to speak without fear of judgment or negative consequences. This atmosphere of trust is essential for ensuring truthful and in-depth responses. Another important aspect is the psychologist's ability to recognize signs of trauma. Victims of violence often exhibit intense emotional reactions or trauma-related disorders, and only a professional can identify these reactions and adjust their approach to avoid re-traumatizing the interviewee.

Some questions, in this questionnaire, can be highly intimate and difficult, and handling such questions requires particular care and sensitivity. A professional can guide the woman through these questions, explaining their purpose and reassuring her that she is not obliged to answer if she feels uncomfortable. This helps to reduce distress and ensures better comprehension of the questionnaire.

Another reason why the involvement of a professional in questionnaire administration is crucial concerns the quality and accuracy of the data collected. Violence is a complex issue, and a professional has the skills to formulate and collect information accurately, avoiding distortions or misinterpretations. Additionally, if information arises that indicates immediate danger or a need for urgent help, the professional can intervene by guiding useful resources, such as domestic violence centers or legal and psychological support.

Lastly, a professional knows how to manage incomplete or ambiguous responses, adjusting the interview without forcing answers, and understanding the power and control dynamics that often accompany violent situations.

## DISCUSSION

Despite increasing awareness of gender-based violence, its impact on women's long-term health remains understudied and understood. The physical, emotional and psychological scars left by violence often linger for years, yet medical and public health systems often lack the means to assess the full extent of these impacts. Chronic conditions, such as PTSD, can develop as a result of prolonged trauma, yet the complex relationship between violence and long-term health remains underrecognized and unaddressed in most medical settings.

The EpiWEAT, designed to evaluate and gather data on violence against women, holds significant potential for both immediate and long-term applications in healthcare, social services, and law enforcement. By centralizing critical information about the context of violence, the victim-perpetrator relationship, and the presence of physical and psychological symptoms, this tool provides a comprehensive resource for professionals to offer tailored support to women experiencing violence. In the short term, the tool's use will facilitate more accurate risk assessments, ensure better coordination between healthcare providers, and guide the implementation of preventive measures aimed at mitigating long-term health consequences, particularly chronic and non-communicable diseases linked to violence.

The EpiWEAT could be expanded to other settings beyond Italy, allowing for broader geographic applicability. While currently designed to operate in the Italian context, with the potential for adaptations into other languages, its framework offers a flexible model that could be tailored to different cultural, social, and healthcare systems. As such, the tool could be implemented internationally, providing data that can inform global health policies aimed at improving the outcomes of women suffering from violence. Additionally, this tool could serve as a valuable component in large-scale longitudinal studies, contributing to a deeper understanding of the relationship between violence, epigenetics, and long-term health effects.

In terms of practical use, the integration of the tool into the routine practice of healthcare professionals, social workers, and law enforcement officers would be critical to ensure its success. Training professionals in its use and interpreting the data gathered will be an essential step toward establishing the tool as a routine part of the support infrastructure for women who have suffered violence. This also provides an opportunity for continuous improvement of the tool, through feedback from end users and the incorporation of emerging scientific evidence into future iterations.

The broader implications of this tool lie in its potential to influence healthcare practices and policies related to violence against women. By linking the psychological and physical effects of violence to biological markers, it opens a pathway for the integration of precision medicine into the management and care of women who have experienced violence. This approach acknowledges the need for gender-sensitive care and offers a model for addressing the long-term health needs of survivors in a more holistic manner. Additionally, by incorporating epigenetic analysis, this tool could help to highlight the biological impact of violence and contribute to an evolving understanding of the mechanisms underlying trauma, potentially influencing how healthcare systems approach trauma-informed care.

In the future, multisectoral public health interventions are required, where strong scientific bases are integrated with rigorous statistical analysis, as well as clinical and regional welfare analysis. In a few years it will be possible to make a specific prevention, starting from the epigenomic profile of the woman who has suffered violence by preventing the long-term outcomes caused by the onset of non-communicable, chronic, and disabling pathologies such as cancer or cardiovascular or autoimmune diseases. Precision prevention medicine can guarantee specific care to help women who have experienced violence become more resilient.

## CONCLUSIONS

In conclusion, there is strong evidence to suggest that this questionnaire will provide valuable insights and raise awareness about violence, helping to shift priorities in managing the everyday challenges associated with various forms of illness for women who have experienced abuse and violence. The interdisciplinary approach to

analyzing violence against women brings together a range of theoretical perspectives, such as public health, epigenetics, psychology, and sociology, each offering a unique lens through which to understand this complex issue. The goal is to stimulate new, innovative research that bridges these disciplines, ultimately leading to the development of public health policies aimed at improving the well-being of women in the medium term.

By integrating personal data with epigenomic analysis, we can significantly enhance our understanding of individual health profiles, thereby refining precision prevention strategies. Combining genetic data with factors like exposure to violence, lifestyle choices, environmental influences, and behavioral patterns will provide a clearer picture of a person's health risks, allowing for more tailored preventive measures. For example, epigenetic markers can reveal how a person's environment or decisions have influenced their gene expression, potentially contributing to diseases like cancer or heart disease. When these insights are paired with personal health information, such as medical history, family background, and real-time health monitoring, they open the door to more personalized, proactive interventions. The future of precision prevention relies on this integration, as it enables targeted risk assessments and more effective preventive measures. It will not only help predict the conditions someone is at risk for but also when they might develop them and how they will respond to various treatments or interventions.

### *Ethics Committee*

The EpiWEAT was approved by the National Ethics Committee of the Italian National Institute of Health (Istituto Superiore di Sanità, ISS), Rome, Italy (Protocol number: PRE BIO CE n. 4113 del 30 January 2025).

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### *Authors' contributions*

MG, AC and SG conceived and designed the study and wrote the manuscript. DLB, EC, PM, GC, MGFB, AP, PC revised and edited the manuscript. All Authors revised the manuscript for important intellectual content and agreed with this article's contents.

### *Conflict of interest statement*

The Authors declare no competing interests.

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