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Intimate Partner Homicide Risk Assessment by Police in Spain: The Dual Protocol $VPR_{5.0}$-H

Juan J. López-Ossorio[a, b], José L. González-Álvarez[a, b], Ismael Loinaz[b, c], Ana Martínez-Martínez[d], and David Pineda[d, e]

[a]Gabinete de Coordinación y Estudios, Secretaría de Estado de Seguridad, Spain; [b]Instituto de Ciencias Forenses y de la Seguridad (ICFS), Universidad Autónoma de Madrid, Spain; [c]Grupo de Estudios Avanzados en Violencia (GEAV), Universidad de Barcelona, Spain; [d]Unidad de Psicología Forense, Universidad Miguel Hernández de Elche, Spain; [e]Facultad de Psicología, Universidad Nacional de Educación a Distancia, Madrid, Spain

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A B S T R A C T

Spanish police makes an extensive use of intimate partner violence (IPV) risk assessment on a daily basis. Improved prediction procedures have encouraged the search for greater refinement of IPV predictors by adjusting to specific targets, such as lethal outcomes or potential victimization of children. This paper describes the evolution of the $VPR_{5.0}$ tool (VioGén System Police Risk Assessment) as an algorithm aimed at improving predictability of intimate partner homicides (IPH). A sample of 2,159 records was used, 159 of whom were IPH victims. The sample was divided into two comparable groups of cases (IPH) and controls (N-IPH) to validate the results. The results showed that 13 out of 35 risk factors were significantly related to IPH with an effect size different to that of general N-IPH (with *OR* values ranging between 1.507 and 8.087). Binary logistic regression showed six significant factors that correctly classified 86.3% of the IPH. The new H-Scale performance parameters were comparable to those obtained in studies with the same objective (sensitivity 84%, specificity 60%, *OR* = 8.130, AUC = .80, PPV = .19 and NPV = .97).

La valoración policial del riesgo del homicidio de pareja en España: el protocolo dual $VPR_{5.0}$-H

Palabras clave:
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R E S U M E N

La policía española hace un uso diario y extenso de la evaluación del riesgo de violencia en casos de violencia de género (VCP). El perfeccionamiento de los sistemas de predicción de VCP ha impulsado la búsqueda de procedimientos ajustados a objetivos concretos, como puede ser el resultado letal o la inclusión de menores como posibles víctimas. En el presente trabajo se describe la evolución de la herramienta $VPR_{5.0}$ (Valoración Policial del Riesgo del Sistema VioGén) a un algoritmo diferenciado cuyo objetivo es predecir mejor los homicidios de mujeres por su pareja (HCP). Se analizaron 2,159 registros, 159 de los cuales correspondían a HCP, dividiendo la muestra en dos grupos comparables con casos (HCP) y controles (N-HCP) para validar los análisis. Los resultados pusieron de manifiesto que de los 35 factores de la herramienta 13 estaban asociados significativamente con el HCP, con un tamaño del efecto diferente al de N-HCP (con valores *OR* entre 1.507 y 8.087). La regresión logística binaria mostró seis factores significativos que clasificaban correctamente el 86.3% de los HCP. Los parámetros de rendimiento de esta escala-H resultaron comparables a los obtenidos en estudios con el mismo objetivo (sensibilidad 84%, especificidad 60%, *OR* = 8.130, AUC = .80, VPP = .19 y VPN = .97).

Intimate partner violence (IPV) is a complex phenomenon that occurs to varying degrees in all countries, cultures, and societies. An extreme manifestation of this violence is homicide. Violence at this level creates great social alarm while also having important repercussions on the social environment of victim, perpetrator, and society in general (López-Ossorio et al., 2018). Homicides have multifaceted origins. Fight against homicides is enshrined in the global goals of sustainable development as highlights how women and girls throughout the world are affected by it. There were approximately 87,000 homicides of women in 2017 (UNODC, 2019). While this total indicates a decrease over previous years, an alarming fact is that the number of homicides of women in the context of family and couples increased from 47% in 2012 to 58% in 2017. Although approximately 81% of all homicide victims are men, this figure changes substantially

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Correspondence: dpineda@umh.es (D. Pineda).

when intimate partner homicide (IPH), where 82% of victims are women, is recorded (UNODC, 2019). These figures confirm the findings of previous studies by Stöckl et al. (2013).

It is estimated in the U.S. between 2003 to 2014 that 55% of all homicides against women were IPV-related. In addition, 7% of homicides had adolescent victims; only 18% of them had a prior history of violence being inflicted against them (Adhia et al., 2019). In Europe, Spain, Holland, Italy, and Scotland are among the countries and regions with the lowest IPH rates, less than 0.20 murders per 100,000 inhabitants. Other countries, such as Albania, Iceland, Hungary, and Croatia, have higher IPH rates, above 0.40 murders per 100,000 inhabitants (UNODC, 2019). These data stand in contrast to the higher prevalence of IPH in countries such as Sweden, Iceland, and Finland, which historically are much more equal in terms of women's rights and freedom. IPH rates in some of these countries approximately triple the Spanish rate, a phenomenon known as the "Nordic paradox" which has not yet been clearly explained (Gracia & Merlo, 2016). Complementarily, in Europe low IPH levels do not always correspond with low IPV levels (UNODC, 2019).

Regarding the number of women murdered in Spain by their male partners, official data indicate reduction from about 70 cases per year during the 2003 to 2010 period to less than 50 over the past two years (Ministry of Health, Social Policy, and Equality [MSPSI, 2018]). Although this phenomenon has a low prevalence in Spain, the personal and social impact of this violence is very high, requiring the investment of effective resources for its prevention. In Spain, the reported recidivism to one year in IPV is 15% (López-Ossorio, Loinaz, et al., 2019), and the approximate IPH rate is 0.30 per 100,000 women. The need to improve prediction and prevention systems is heightened when these abstract figures are translated into actual numbers of victims of this violence.

One of the most important approaches in the field of IPV recidivism prevention involves risk assessment and management. Violence risk assessment has a long history and has also been applied in numerous criminal typologies (Bloom et al., 2005; Harris et al., 2015; Loinaz, 2017; Singh et al., 2016). In the case of IPV, its use is particularly important for police, who are usually in charge of case management. In daily practice, therefore, we would have a predictive interest (i.e., differentiating cases and anticipating and predicting types of violence) focused on prevention (i.e., implementing the necessary measures so that the anticipated outcome does not occur, especially in the most serious cases). Graham et al. (2019) have recently pointed out that there is a great variety of tools that aim to assess IPV risk. However, part of the research has focused on analyzing applications as determined by researchers with an academic profile and not by frontline professionals, such as the police. The degree of homogeneity of samples (e.g., same-sex couples or female perpetrators are not taken into account), as well as their predictive, rather than preventive, study aims are among the limitations of earlier studies. There are also major differences in the statistical validity indicators of the instruments used in previous research, which complicates comparison between studies.

In order to prevent both lethal and non-lethal violence, correct risk assessment is essential. If homicide is understood as the ultimate expression of violence, it could reasonably be anticipated that IPV tools would adequately predict this phenomenon in the presence of a high risk. However, in the majority of previously reported IPH it was frequently observed that the latest police risk assessments had low predictive rates because there were not enough risk indicators identified to warn of the possible IPH. This has often been erroneously interpreted as a failure of those assessments (MSPSI, 2018). This homicide phenomenon, at least partially different and much more complex than recidivism in IPV, requires complementary preventive strategies (Cunha & Gonçalves, 2016; Dobash et al., 2009; Heron, 2017; López-Ossorio et al., 2018).

The need to identify IPH risk factors that make it possible to predict the phenomenon and identify people with the greatest potential for harm has previously been highlighted (Weil et al., 2018). Research on IPV risk factors is extensive and has allowed us to contribute in parallel with advances in IPH. The review of current knowledge on couples' homicides leads us to question whether prediction is possible when dealing with subjects having different profiles, different motivations, and different risk factors (López-Ossorio et al., 2018). Among available studies on the topic are descriptions of a series of IPH (Belfrage & Rying, 2004; Caman, Kristiansson, et al., 2017; González-Álvarez, Garrido, et al., 2018; Kivivuori & Lehti, 2012); profiles of IPH offenders (Dobash & Dobash, 2011; Dobash et al., 2009); differences between batterers and IPH offenders (Cunha & Gonçalves, 2019; Dobash et al., 2007; Jung & Stewart, 2019); comparison of IPH offenders and other homicides (Caman, Howner, et al., 2017; Dobash et al., 2004; Juodis et al., 2014); and IPH and homicides of women outside of intimate relationships (Dobash & Dobash, 2015; Loinaz et al., 2018; Zara et al., 2019).

Broadly speaking, research could be summarized as follows: most IPH cases are perpetrated by current of former intimate partners; IPH share many characteristics with other homicides, although IPH offenders are more normalized (socially adapted) than perpetrators of other types of homicide; there is no single IPH profile, and offender typologies must always be established; many cases do not have an official history of previous violence; finally, prevalence of these cases is very low. As a consequence of these factors, predictive ability is very complicated. Contradictory studies point to differential predictors and less normalized profiles in IPH (Eke et al., 2011; Juodis et al., 2014; Kivivuori & Lehti, 2012).

Because of this heterogeneity and the dimensional nature of violence, IPV risk assessment tools tend to have a global predictive target – e.g., Spousal Assault Risk Assessment guide (SARA), Brief Spousal Assault Form for the Evaluation of Risk (B-SAFER), *Protocolo de Valoración del Riesgo de Violencia contra la Mujer por parte de su Pareja o Expareja* (RVD-Bcn) –, although some have focused in particular on predicting homicide – e.g., Danger Assessment (DA) – or more serious assaults – e.g., *Valoración Policial del Riesgo* (VPR), *Escala de Predicción del Riesgo de Violencia Grave contra la pareja-Revisada* (EPV-R), Ontario Domestic Assault Risk Assessment (ODARA). Performance parameters of different tools have been reviewed and published in a variety of papers (Nicholls et al., 2013).

In summary, findings related to reliability and validity of these risk assessment tools are similar to those obtained with Spanish tools (Echeburúa et al., 2010; Loinaz, 2014; López-Ossorio et al., 2016; López-Ossorio, González-Álvarez, et al., 2019). In some cases, it has been pointed out that the combined use of two tools with different formats, such as SARA and ODARA, increases their predictive capacity (Olver & Jung, 2017).

A problem for IPH prediction arises when the homicidal aggressor does not present risk factors and escapes assessment systems (Dixon et al., 2008). In a recent meta-analysis, Spencer and Stith (2018) point to factors with the greatest potential for predicting IPH: direct access to a gun, history of non-fatal strangulation, rape of the victim, threats with a weapon, controlling behaviors, and previous threats of harm. In addition, numerous papers point to the importance of obtaining data on suicide indicators to prevent these homicides (Bridger et al., 2017). Studies such as those by Campbell et al. (2003) also suggest the existence of risk factors that predict IPH: history of mistreatment, separation processes, harassment, substance abuse, mental disorder, and access to firearms, giving rise to the development of the DA tool (Campbell, 2012; Campbell & Glass, 2009; Campbell et al., 2003; Campbell et al., 2009), which was designed for applied use as a victim interview technique.

Policing tools tend to have an easy-to-apply actuarial design that seeks both to maximize response potential and to streamline the implementation process (Messing, Campbell, Sullivan, et al., 2017). An international example is the Ontario Domestic Assault Risk Assessment (ODARA) (Hilton & Eke, 2016; Hilton et al., 2001; Hilton et

al., 2004), which contains 13 unweighted risk factors that link results to recidivism rates. This tool has been used in several ways: to analyze usefulness of online training for users (Hilton & Ham, 2015), as an indicator of female perpetrators' risk (Hilton et al., 2014), and for the assignment of appropriate treatment to different aggressors (Radatz & Hilton, 2019). On the other hand, adaptations of structured judgment tools for this context have tended to be brief, such as the B-SAFER derived from SARA (Kropp, 2008; Loinaz, 2014; Svalin et al., 2018), or a brief version of DA (Messing, Campbell, Sullivan, et al., 2017).

The field of police prediction has also undergone notable developments with the creation of new tools in the international environment, such as SVRA-I (Dayan et al., 2013) or VP-SAFvR (McEwan et al., 2019), or in the Spanish field with Police Risk Assessment (VPR) (López-Ossorio et al., 2017; López-Ossorio, González-Álvarez, et al., 2019), and EPV-R (Echeburúa et al., 2010). In addition, analysis of police risk management has also been a focus of attention (Belfrage et al., 2012; McEwan et al., 2017; Perez Trujillo & Ross, 2008; Storey et al., 2014; Svalin et al., 2018; Svalin et al., 2017). There are other specific tools for assessing IPH risk, such as MOSAIC-20 or the Maryland Network Against Domestic Violence through the Lethality Screen for First Responders questionnaire (Messing, Campbell, Sullivan, et al., 2017).

In Spain, work on Form $VPR_{4.0}$ robustness allowed its evolution to version 5.0 (López-Ossorio, Loinaz, et al., 2019), stabilizing performance parameters for one year, incorporating a new indicator linked to aggressors under the age of 24 and consolidating its 35 current risk indicators (see Method section for a more detailed discussion). These adjustments have reduced the margin of error (false positive) of the lowest levels of risk of between 8.3-13.7%, and the two highest levels of risk provide a correct classification of 54.1% of recidivism in their categories. It also achieves some improvements in its performance parameters (Cabinet of Coordination and Studies, 2017: sensitivity 82%, specificity 34%, AUC = .64 [.62, .66], PPV 17%, NPV 92%, *OR* = 2.4 [2.0, 2.8]). Despite being an actuarial system, its focus is not only on risk assessment, but especially on risk management (which is more common in structured professional judgment methodologies than in actuarial systems), with different specific mechanisms managed and coordinated from the VioGén System. Thus, one of the inherent consequences of research is that risk management tends to affect false positives due to victim protection (risk subjects who are managed and who, therefore, are not expected to relapse despite having been given a high-risk determination).

Since IPV and IPH prediction may stem from different factors, the aims of this study were first to determine specific IPH risk factors, in contrast to those of general IPV in Spain and, second, to improve IPH prediction through the development and validation of a new scale to provide an estimation of homicide risk complementary to the main algorithm of the $VPR_{5.0}$-H scale.

Method

Participants

In 2007, the Spanish Ministry of the Interior implemented the VioGén System (González-Álvarez, López-Osorio, et al., 2018), which collects and manages all national information, mostly from police reports, on intimate partner violence against women. The system corresponds with the actuarial recidivism risk assessment tool used by specialist police officers ($VPR_{5.0}$) to articulate protection measures based on the level of risk. Cases are periodically re-evaluated using a complementary form (Police Risk Evolution Assessment) ($VPER_{4.1}$; López-Ossorio, González-Álvarez, et al., 2019). A total of 2,159 records from the VioGén System were used in the current study. In all the records, the perpetrator was a man and the victim a woman. Of these, 2,000 (92.6%) did not result in death (control group; N-IPH) and 159 (7.4%) were IPH (case group). The 2,000 records of the N-IPH group corresponded to random denunciations registered in the VioGén System in the last quarter of 2016. In this group, victims had an average age of 34.5 years (*SD* = 13.03, range = 13-68). Reported aggressors' mean age was 36.51 years (*SD* = 14.57, range = 14-68); 65.7% of the victims and 67.9% of those reported were of Spanish nationality; 65.0% of complaints were filed in urban areas and 35.0% in rural areas, estimated according to territorial competences of police forces.

A total of 159 homicides from the sample, for which risk assessment information was available, occurred between February 2006 and September 2018 (only 14.5% of IPH occurred before 2011, and 55.3% after 2013), a period in which 759 IPHs were committed as confirmed by the Government Delegation for Gender Violence. Thus, the sample of homicides corresponds to 20.9% of the total for that period. Average age of women who died was 41.49 years old (*SD* = 14.66, range = 14-77) and 68.0% were Spanish; 27.6% of the sample had previously denounced the aggressor for at least one episode of violence (percentage similar to the 25.9% of denunciations present in the total number of IPH cases of the mentioned period). Regarding homicides, average age was 46.38 years (*SD* = 14.56, range = 19-86) and 70.7% were Spanish; 48.7% of IPH cases occurred in urban areas and 51.3% in rural areas. The percentage of suicide consummated after the homicide of the analyzed sample was 22.0%, and in all homicides of the period it was 20.2%. It is considered that samples are representative of their study populations and comparable, except for the fact that of IPH cases do not maintain the same temporal correspondence or simultaneity of N-IPH cases due to the fact that the temporal range had to be extended because of the low prevalence of homicides.

Instrument

Form $VPR_{5.0}$, composed of 35 dichotomously coded risk factors (present/absent), provides five levels of risk: unappreciated, low, medium, high, and extreme. Factors are grouped into five dimensions: 1) history of intimate partner violence; 2) factors related to the offender; 3) indicators related to victims' vulnerability; 4) circumstances related to minors; and 5) aggravating circumstances and subjective aspects of a victim's own risk.

Design and Procedures

For the development of the study we used an epidemiological design, observational analytical cases (IPH) and controls (N-IPH), which allows the construction of a predictive level model based on bivariate statistics to know odds ratio (*OR*) of factors predicting IPH, and multivariate procedures to analyze confusion of measures. For the 159 homicides, evaluations of cases with a previous report were used, and $VPR_{5.0}$ in unreported cases were completed by professionals with the same training considering the information granted by Spanish fatality review teams (González-Álvarez, Garrido, et al., 2018).

Six hundred records were randomly selected from the 2000 N-IPH (non-lethal violence) that, together with the 159 IPH cases (600+159), formed a first data matrix used to identify risk factors probabilistically associated with IPH events through contingency tables and estimation of their OR. The ratio of IPH and N-IPH was very close to 1:4, increasing the number of "controls" per "case" to the maximum advisable for epidemiological studies, especially in the identification of risk factors with outcomes of low prevalence or "rare events", as statistical power increased (Fletcher et al., 2014). Once the risk factors were obtained, the next step was the development and validation of the H-Scale. In order to maximize stability of measures, a procedure of cross validation with two other matrices was chosen, so that for the development matrix 60% of the randomized sample of IPHs and N-IPHs was used (*n* = 936), and for obtaining validation parameters (validation matrix) the remaining 40% (*n* = 623), following the same

Table 1. Risk Predictors for Intimate Partner Homicide IPH (N = 759)

Predictors	Coefficient		(χ^2)	% Valid
	OR	95% CI		(n = 759)
Significant positive relationship				
Suicide threats from the aggressor	8.087***	[4.014, 16.295]	45.685	99.9
The perpetrator shows exaggerated jealousy or suspected infidelity of his partner in the last six months.	1.507*	[1.057, 2.149]	5.175	93.9
The perpetrator shows controlling behaviors in the last six months.	1.725**	[1.202, 2.478]	8.839	94.9
Presence of problems in his life (stress) in the last six months.	3.338***	[2.298, 4.850]	42.153	85.5
The perpetrator has economic or work-related problems in the last six months.	6.324***	[4.247, 9.419]	94.955	100
Presence of past breakings of sentence conditions	2.634**	[1.384, 5.011]	9.292	96.7
Presence of physical or sexual aggression records	1.577*	[1.031, 2.412]	4.455	97.1
The perpetrator presents a mental or psychiatric disorder	3.384***	[2.003, 5.716]	22.659	88.0
Presence of suicidal ideas or attempts	1.994**	[1.300, 3.057]	10.262	92.0
Presence of any kind of disability in the victim	2.020*	[1.033, 3.952]	4.374	98.2
Mental or psychiatric disorder in the victim	3.221***	[1.682, 6.168]	13.672	97.0
Any kind of addiction or engages in substance abuse (alcohol and drugs) in the victim.	5.101***	[2.784, 9.346]	32.989	95.9
History of gender or domestic violence within victim's family.	4.063***	[1.941, 8.502]	15.919	100
Non-significant positive relationship				
Psychological violence	0.525*	[0.357, 0.774]	10.794	98.0
Physical violence	0.340***	[0.237, 0.486]	36.430	99.3
Sexual violence	1.539	[0.875, 2.706]	2.270	97.4
Threatened victim with a cutting weapon	1.082	[0.483, 2.423]	0.370	100
Threatened victim with a firearm	3.791	[0.236, 60.947]	1.022	100
Minor threats to harm the victim	0.448***	[0.301, 0.666]	16.129	72.3
An escalation of aggression in the last 6 months	0.665*	[0.456, 0.942]	5.261	95.1
In the last year the aggressor has caused material damage	0.329***	[0.505, 0.230]	22.501	94.7
In the last year they have disrespected an authority figure	0.760	[0.385, 1.501]	0.627	92.0
In the last year they have committed an aggression against third parties or animals.	0.560	[0.302, 1.039]	3.459	93.0
In the last year they have made threats and slights towards third parties.	0.636	[0.402, 1.006]	3.791	91.3
Presence of a criminal record	1.015	[0.713, 1.443]	0.007	100
Presence of records of gender violence against other intimate partners.	0.507*	[0.285, 0.901]	5.537	96.7
Presence of any type of addiction or abuse of alcohol or drugs.	0.875	[0.613 ,1.248]	0.545	92.6
The aggressor has a family history of being abused	0.668	[0.377, 1.184]	1.928	73.4
Victim has no social support	1.174	[0.750, 1.838]	0.491	96.4
Victim of foreign origin	1.386	[0.941, 2.041]	2.736	99.6
Victim is economically dependent on the aggressor	1.318	[0.837, 1.992]	1.729	95.5
The victim has minors' members under their care	0.463***	[0.322, 0.665]	17.776	98.0
The victim has suffered gender violence by the hands of other aggressors in the past.	0.487*	[0.275, 0.863]	6.291	98.7
The victim has communicated to the aggressor their desire to end the relationship at least 6 months ago.	0.521***	[0.365, 0.745]	13.046	95.0
The victim thinks that the aggressor is capable of killing her.	0.131***	[0.076, 0.225]	67.242	87.7

Note. OR = odds ratio; [1]CI 95%.
significant value (r) for risk $^{*}p < .05$, $^{**}p < .01$, $^{***}p < .001$.

procedure to avoid duplicity and that no control was really a case or that was repeated in two matrices.

Due to the fact that the research project was oriented from the beginning to the construction and validation of a procedure that would allow to improve predictions of the IPH risk, three requirements were established: IPH risk factors had to demonstrate their association with the mortal outcome, obtaining their own mathematical weight (OR), no matter if it was different from the one used for the lower intensity relapse; risk factors had to be shared with the base instrument already in use ($VPR_{5.0}$) to avoid agents having to make two assessments; and, finally, the ultimate predictive model should improve current $VPR_{5.0}$ predictions for IPHs.

Data Analysis

IBM Statistical Package for Social Sciences (SPSS v20) was used. Independent variables were risk factors from $VPR_{5.0}$, and the dependent variable was fatal outcome. To determine statistical significance, contingency tables were used and Pearson and *OR* test χ^2 was calculated. In order to verify that results of contingency tables are not due to chance, it was confirmed that *OR* value range did not contain the unit and the conditional independence test χ^2 of Mantel-Haenszel was estimated. Raw *OR* results from the bivariate model were also optimized through binary logistic regression. Performance parameters were estimated using the elements of test discrimination (*OR*, sensitivity, and specificity) and calibration with the positive predictive value (PPV) and the negative predictive value (NPV). The statistical analyses of predictive validity were completed with ROC curves to obtain the area under the curve (AUC).

Results

IPH Risk Factors

The analysis of IPH predictors with the first matrix (600 + 159) showed that 13 of the 35 indicators present in $VPR_{5.0}$ were significantly associated with fatal outcomes (see Table 1). *OR* obtained ranged from 1.507 for the aggressor's jealousy to 8.087 for his suicide threats. A third of indicators belonged to circumstances of the victim, and most to perpetrator's sphere. The results of the binary logistic regression analysis showed that six factors could correctly classify 86.3% of cases (Table 2).

H-Scale Development and Performance Parameters

One of the aims of the study was to develop an IPH risk assessment tool that could be used by the computer system at the same time that the global tool ($VPR_{5.0}$) is applied by police officers/clinicians, and various tests were carried out to assess the best option and predictors.

The first technical initiative was aimed at improving prediction of IPH with the $VPR_{5.0}$, including new weights obtained for the 13 significant factors (Table 1). However, the different combinations did not show any optimal results, because if the prediction of IPH was improved that of recidivism would decrease, and vice versa. The predictive model derived from the six risk factors of the logistic regression offered similar results to that of the 13 factors. Given these results, it was decided that the H-Scale be constructed using the 13 risk factors. Once the results of the ROC curve were obtained, the best cut-off points were optimized for three risk levels classified by the H-Scale: low level up to 3.232, medium level up to 12.883, and high level with scores above 12.883. The construction method was of an actuarial weighted additive type, adding the specific OR value with the IPH of each present item. As a screening mode, the aim was to reduce the rate of false negatives (FN), valuing sensitivity over specificity. In the validation matrix, low risk level comprised 56.0% of the sample and 15.9% of the IPH (FN); medium risk level comprised 31.3% of the sample and 36.5% of the IPH; and high risk level comprised 12.7% of the sample and 47.6% of the correct classification of IPH, with a true positive rate of 84.1% (TP).

Performance parameters with respect to predictive validity, calculated with a development matrix and a validation matrix, showed high consistency (Table 3), with great similarity of AUC values confidence intervals. Estimators found in both matrices were very similar. *OR* as indicators of measure of effect and increase of risk ranged from 6.70 to 8.13. *OR* for high-risk level was 9.481 (5.336, 16.844, $p < .001$); thus, a risk assessment of this classification increases almost 10 times the probability of an extremely serious event. Sensitivity ranged from 81% to 84% and specificity from 61% to 60%. PPV, which indicates the proportion or percentage of individuals correctly classified as at risk, stood at 19%, despite the fact that the percentage of false positives remained high. NPV, which indicates the proportion of individuals correctly classified as low risk, reached 97%. Of the total number of cases classified as low risk (56.0%), only 2.9% were incorrectly classified. The cut-off point at low risk level was used to make these calculations.

Table 2. Logistic Regression Coefficients for Binary Outcomes

Predictors	*B*	*SE*	Wald χ^2	*p*	exp(*B*)	95% CI [lower-upper]
Suicide threats from the aggressor	1.743	0.552	9.978	.002	5.714	[1.938, 16.849]
The perpetrator shows controlling behaviors in the last six months	0.700	0.309	5.132	.023	2.015	[1.099, 3.693]
The perpetrator has economic or work-related problems in the last six months	1.562	0.321	23.707	.000	4.768	[2.543, 8.941]
Presence of physical or sexual aggression records	0.956	0.392	5.937	.015	2.602	[1.206 ,5.614]
The perpetrator presents a mental or psychiatric disorder	1.492	0.402	13.782	.000	4.446	[2.022, 9.773]
Presence of any kind of disability in the victim	1.286	0.636	4.091	.043	3.617	[1.041, 12.571]

Note. EXP(*B*) = hazard ratios; CI = confidence interval; *SE* = standard error.
Model summary. Cox & Sell's chi-square $R^2 = .153$; Nagelkerke's chi-square $R^2 = .279$; Hosmer & Lemeshow's χ^2 (4, $n = 623$) = 5.00. $p = .287$.

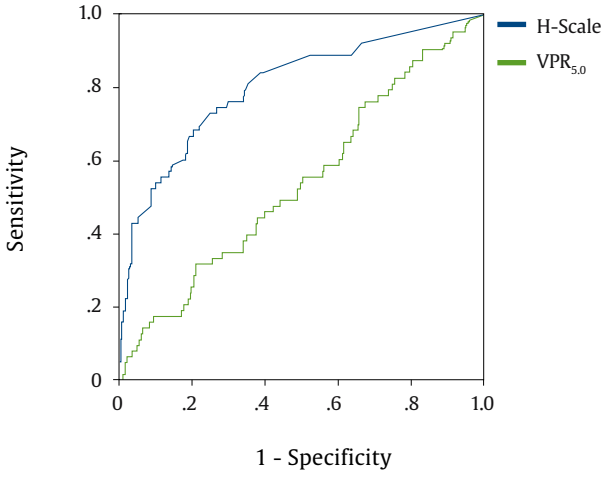
Table 3. Efficacy and General Predictive Validity of Total Scores in Development and Validation Samples for the H Scale

Performance parameters	Development matrix (n = 936) H-Scale	Validation matrix (n = 623) H-Scale
OR	6.70 [3.94, 11.39]	8.13 [4.05, 16.32]
Sensitivity	.81	.84
Specificity	.61	.60
AUC	.81 [.76, .86]	.80 [.74, .86]
PPV1	.19	.19
NPV	.97	.97

Note. CI = 95%; *OR* = odds ratio; AUC = area under the receiver operating characteristic curve; PPV= positive predictive value; NPV= negative predictive value. [2]Base rate (%) development matrix = 10.25% and validation matrix= 10.11%.

The AUC obtained from the H-Scale was .80 (IC .74 - .86), the standard error was low for variance estimation of the area and the *p*-value was very significant, being able to determine that this estimator offers good discriminant capacity. Figure 1 illustrates differences in predictive capability of the H-Scale and non-dual Form $VPR_{5.0}$ for estimating IPH risk.

Figure 1. ROC Curve of the H-Scale and Non-dual Form $VPR_{5.0}$ for Estimating IPH Risk. Validation Sample (n = 623).



	AUC	*SD*	*p*	95% CI
H-Scale	.802	.032	.000	[.739, .865]
$VPR_{5.0}$	.540	.039	.292	[.466, .616]

Discussion

The aim of the study was to test whether factors in the $VPR_{5.0}$, the Police Risk Assessment Form for IPV recidivism used by most law enforcement agencies in Spain, were capable of discriminating IPH cases. In addition, the idea was to develop a specific tool for the prediction of homicide that could be corrected by the system at the same time as $VPR_{5.0}$ was applied (same application of VPR allows to correct a parallel algorithm specific to homicide with specific significant factors).

Of the 35 risk factors present in the tool, 13 were significantly associated with IPH, with effect sizes different from prediction of non-lethal IPV. Four factors from a victim's sphere were relevant, which had not been observed in previous studies regarding prediction of risk of non-lethal recidivism (López-Ossorio et al., 2017). This aspect would confirm differences pointed out between IPV and IPH, although there are also common risk factors in both forms of violence (Cunha & Gonçalves, 2019). On the other hand, it should be noted that the aggressor's suicide threats, violation of restraining orders, suicide ideation and attempts, the victim's suffering from some form of mental illness, and the experience of IPH in the victim's family environment had not appeared as relevant for IPH prediction in previous studies, as shown by the meta-analysis by Spencer and Stith (2018).

Clinical circumstances of the aggressor and the victim appear to be important in IPH events, especially in the aggresor's parasuicidal sphere, elements that are not so prominent in IPV violence risk assessment (Loinaz, 2017). Contrary to what might be expected (Campbell et al., 2003), factors such as a history of complaints regarding previous episodes of violence, presence of physical or sexual violence, and use of weapons did not prove to be a differentiating factor between a non-lethal repeat episode and an IPH. The possible explanation is that the IPH sample used in this study is derived not only from cases with previously reported violence (27.6%), but also from others that present different characteristics, including 22% of homicide cases followed by suicide (López-Ossorio et al., 2018). The results in this sense would be similar to those found in the comparison of IPH and IPH in Portugal (Cunha & Gonçalves, 2019).

The H-Scale, composed of 13 factors, presents a sensitivity of 84% and a specificity of 60%, values suitable for this context of application. These values are similar to those obtained with the DA-5 for the same objective: sensitivity 86% and specificity 56% (Messing, Campbell, & Snider, 2017; Snider et al., 2009). The balance between sensitivity and specificity values is always a complicated decision that must be made on the basis of data obtained and considering the context of application (Messing & Campbell, 2016). The specificity should not be of very low value in order to avoid overstretching police resources for the protection of victims. On the other hand, frontline professionals need particularly sensitive screening tools to detect as many cases of interest as possible, even though false positives are increasing moderately (Messing, Campbell, & Snider, 2017). In subsequent assessments in the field of criminal justice, where judicial decisions are of great significance to defendants, greater care should be taken to ensure that the value of specificity is considered. The effect size and predictive capability (*OR* = 8.13 and AUC = .80), together with the rest of discrimination and calibration parameters obtained (PPV = .19 and NPV = .97), are also comparable to those of lethal IPV prediction in the few studies that report them, such as the application of Lethality Screen (Messing, Campbell, Sullivan, et al., 2017). These results confirm those obtained in other research (Graham et al., 2019) and show that the specialization of violence risk assessment instruments achieves higher performance parameters (McEwan et al., 2019). It is important to note that, unlike similar studies such as those developed for VPR by estimating recidivism, in the current work most cases were not under police protection or other circumstances that may modify predictive validity results of the instrument.

The important findings of this study have salient practical implications. Although the H-Scale can be used by different professionals to estimate the specific risk of IPH, in contexts where subsequent risk management is required (such as policing), the results obtained show that to improve combined estimates of recidivism and homicide, a dual mechanism of measurement is recommended. Therefore, a first result is obtained for risk of recidivism in IPV with $VPR_{5.0}$ and another specific result for

risk of homicide using the H-Scale, which allows the level of risk to be automatically adjusted from the two estimates: recidivism and homicide. This entails a special degree of protection for cases identified as more serious (specifically, in cases initially classified as unappreciated risk, low, and medium risk). This new combined procedure is called $VPR_{5.0}$-H and provides information on both risks (IPV and IPH) independently and integrated into a single risk report (Secretaría de Estado de Seguridad [SES, 2019]). Thus, after the agent assesses current $VPR_{5.0}$ risk factors the VioGén System provides a level of recidivism risk that is re-evaluated by the H-Scale. This second automatic analysis makes it possible to identify the risk of IPH at unappreciated, low, and medium levels of $VPR_{5.0}$ and to reclassify cases with the highest risk of IPH at levels higher than those initially obtained, thus increasing their protection.

The different itineraries that can lead to an outcome as violent as IPH lead us to consider the unknowns raised by many cases and which may be invisible to traditional prevention mechanisms employed in the face of non-lethal IPV aggressions. The results of this study suggest that calibration of validated instruments to predict IPV may be inadequate for many potential cases of lethal violence, especially considering the possibility that there had not been a previous complaint. While it cannot be definitively stated that there are many risk factors specific to IPH, this research highlights that main axis of analysis is to know as rigorously as possible their relevance, which has been presented in this study through the size of the specific effect of IPH risk factors. We understand that the new $VPR_{5.0}$-H dual procedure approaches this objective and also provides quality information for risk management by reporting more accurate information to the Justice System for additional risk assessments (Messing & Thaller, 2013). The evaluating agent will obtain the final result in a computerized form and, in those valuations identified as higher risk, the VioGén System qualitatively complements the report that is usually sent to the Justice System on police risk assessment. A further purpose is to propose a complementary risk assessment by forensic team professionals while the risk is managed by police officers. The new tool is presently calibrated for use in the police field, where risk management assessment takes precedence. However, in other professional fields, such as the Justice System, its usage might benefit from recalibration (Muñoz & López-Ossorio, 2016). Following international preventive recommendations, within the framework of the ecological model, which contributes to "more efficient and effective risk assessments" (UNODC, 2018); Weil et al., 2018), IPH risk prevention should not conclude with police actions but should be integrated in a coordinated and synergistic manner with other institutions.

The study presents some limitations that should be considered. Despite homicide cases accounting for 20.9% of the total number of cases in the period, which was a representative percentage, they may not have included all of the casuistry of a phenomenon as complex as IPH. The information used for the analysis of risk factors comes only from $VPR_{5.0}$ indicators and, as previous studies have indicated, there are certainly other types of important indicators associated with IPHs that have not been considered in this research because they are not accessible to police officers (Spencer & Stith, 2018). Future research should study these aspects in order to determine whether there are other types of risk factors that make it possible to detect and prevent these events, especially in health or social contexts, that make it easier to protect women who do not report to the police. $VPR_{5.0}$-H is a computerized tool used by police forces in Spain, a fact that limits the replicability of the results by teams outside the VioGén System. The usefulness of the variables that comprise the prediction system in applications distinct from the current one is a challenge that would allow us to deepen our knowledge of types of aggressor samples in the future.

Conflict of Interest

The authors of this article declare no conflict of interest.

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