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BASIC RESEARCH ARTICLE

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The effect of individual characteristics on susceptibility to aggressive and/or intimidating approaches: quantifying probability pathways by creating a victimization model

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ABSTRACT

Background: A significant body of literature has identified multiple factors that contribute to established victimization by aggressive and/or intimidating behaviours. These studies primarily originate from the fields of intimate partner violence (IPV), bullying, sexual abuse, and/or commercial sexual exploitation (CSE), and generally focus on female victims. It appears, however, complicated to quantify the cumulative contribution of these factors on susceptibility to intimidating and/or hostile engagements on an individual level.

Objective: To develop a comprehensive risk model to quantify, on an individual level, the cumulative effects of previously reported characteristics on susceptibility to aggressive/intimidating approaches, leading to victimization (e.g. in the context of IPV/sexual abuse).

Methods: A Bayesian belief network was developed using data from previous studies, capturing the multivariate contribution of previously reported characteristics on the likelihood of becoming victimized by aggressive and/or intimidating approaches (e.g. in the IPV/CSE context) in female victims aged 12–24 years.

Results: The model showed that specific combinations of characteristics may contribute to an increased likelihood of victimization (e.g. in the context of IPV/bullying/sexual abuse or CSE). This likelihood could be quantified and categorized into specific clusters of factors differentiating between victimization by physically violent, non-physical, and/or sexual aggressive/intimidating approaches.

Conclusion: The present model appears to be the first to successfully quantify the cumulative contribution of individual characteristics on the likelihood of becoming victimized by aggressive and/or intimidating approaches, typically leading to victimization. Moreover, the present scientific effort and resulting model suggest that there may be a latent variable mediating between the implemented factors and overall outcome, i.e. the susceptibility to aggressive and/or intimidating approaches. From that perspective, the model may also be considered as an initial outline to effectively indicate susceptibility to such approaches.

El efecto de las características individuales sobre la susceptibilidad para interacciones agresivas y/o intimidantes. Cuantificando las redes de probabilidad mediante el establecimiento de un modelo de victimización

Antecedentes: Existe evidencia acumulada significativa que ha identificado múltiples factores que contribuyen a consolidar la victimización a través de conductas agresivas y/o intimidantes. Esta evidencia se origina principalmente de las áreas de violencia doméstica (VD), acoso escolar, abuso sexual y/o trata de personas (TP) que generalmente se enfocan en víctimas mujeres. Sin embargo, resulta complicado cuantificar la contribución acumulativa de estos factores sobre la susceptibilidad para desarrollar interacciones intimidantes y/u hostiles a nivel individual.

Objetivo: Desarrollar un modelo integral para la determinación cuantitativa del riesgo de los efectos acumulativos de las características previamente reportadas sobre la susceptibilidad para desarrollar interacciones agresivas/intimidantes que devengan en victimización (por ejemplo, en el contexto de VD o abuso sexual) a nivel individual.

Métodos: Se desarrolló una red predictiva bayesiana empelando datos de estudios previos y tomando la contribución multivariada de características previamente reportadas sobre la probabilidad de ser victimizado por interacciones agresivas y/o intimidantes (por ejemplo, en el

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Intimidación; agresión; violencia doméstica; susceptibilidad; victimización; factores de riesgo; características; víctima

关键词

恐吓; 侵略; 亲密伴侣暴力; 易感性; 受害; 风险因素; 特征; 受害者

HIGHLIGHTS

- This study constructed a Bayesian belief network of published statistics to quantify the cumulative effects of individual characteristics on victimization (e.g. in the context of IPV/sexual abuse/bullying/CSE).
- The model showed that the likelihood of victimization following aggressive and/or intimidating approaches could be quantified and categorized into three different features: the likelihood of becoming victimized by physically violent, non-physical, and/or sexual aggressive/intimidating approaches. The likelihood of becoming victimized by physically violent and non-

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contexto de VD o TP) en víctimas mujeres de 12 a 24 años.
Resultados: El modelo mostró combinaciones específicas de características que podrían contribuir a un riesgo incrementado de victimización (por ejemplo, en el contexto de VD, acoso sexual, abuso sexual, TP). Esta probabilidad podría ser cuantificada y categorizada en grupos de factores que diferencian la victimización por violencia física de aquella a través de interacciones no físicas y/o agresiones/intimidaciones sexuales.
Conclusiones: Este modelo impresiona ser el primero en cuantificar exitosamente la contribución acumulativa de las características individuales sobre la probabilidad de ser victimizado por interacciones agresivas y/o intimidantes que, por lo general, devienen en victimización. Asimismo, este esfuerzo científico y su modelo resultante sugieren que podría existir una variable latente que sea mediadora entre los factores implementados y el resultado general, siento esta variable la susceptibilidad para interacciones agresivas y/o intimidantes. Desde esta perspectiva, el modelo también podría ser considerado un primer boceto para identificar de forma efectiva la susceptibilidad para estas interacciones.

个体特征对攻击性和/或恐吓性接近的敏感性的影响：通过创建受害模型来量化概率路径

背景：大量文献确定了导致攻击性和/或恐吓行为受害的多种因素。这些研究主要源自亲密伴侣暴力 (IPV)、欺凌、性虐待和/或商业性剥削 (CSE) 领域，通常关注女性受害者。然而，量化这些因素对个人层面上恐吓和/或敌对行为的敏感性的累积贡献似乎很复杂。
目的：建立一个全面的风险模型，以在个人层面上量化先前报告的特征对攻击性/恐吓性方法易感性的累积影响，从而导致受害（例如，在 IPV/性虐待的情况下）。
方法：使用先前研究的数据开发了贝叶斯信念网络，捕获12 岁至 24岁的人先前报告的特征。
结果：模型表明，特定的特征组合可能会增加受害的可能性（例如，在 IPV/欺凌/性虐待，CSE 的情况下）。 这种可能性可以量化并分类为区分躯体暴力、非躯体和/或性攻击/恐吓接近受害的特定因素组。
结论：本模型似乎首次成功量化个人特征对成为攻击性和/或恐吓性接近受害者、通常会导致受害可能性的累积贡献。 此外，目前的科学努力和由此产生的模型表明，在实施的因素和总体结果之间很可能存在一个潜在变量，即对攻击性和/或恐吓性接近的敏感性。 从这个角度来看，该模型也可能被视为有效表明这些接近敏感性的第一个概述。

- physical aggressive/intimidating approaches seems to be predominantly characterized by risk factors such as depressive symptoms and elevated neuroticism. The likelihood of victimization by sexual intimidating approaches seems to be primarily associated with externalizing risk factors (e.g. impulsivity), strengthened by factors related to previous (negative) sexual experiences and early-onset puberty.
- This model could be considered as an initial outline to effectively indicate susceptibility to aggressive/intimidating approaches. The model may therefore be considered an applicable framework for future research to further unravel the complicated aggressive and/or intimidating victim–perpetrator interactions related to victimization.

1. Introduction

Victimization, for example in the context of intimate partner violence (IPV), bullying, sexual abuse, or commercial sexual exploitation (CSE), can hypothetically be associated with an inherent susceptibility to aggressive and/or intimidating approaches by potential perpetrators. Indeed, because of a typical application of aggressive and/or intimidating approaches within this context, they may be considered as instrumental in victimization and/or sustained coercion (e.g. Casassa et al., 2021; Iglesias-Rios et al., 2020). Nevertheless, while multiple factors have been identified that are independently and typically retrospectively associated with victim populations (e.g. symptoms of depression or childhood maltreatment trauma) (Jaeckl & Laughon, 2021; Kulig, 2022; Spencer et al., 2019), their cumulative contribution to the likelihood of becoming victimized for any given individual is unclear. Nonetheless, it seems likely that within the same context, differences in this likelihood can, at least to some extent, be attributed to interindividual differences in susceptibility to aggressive and/or intimidating approaches. This raises the question of the way in which specific combinations of personal characteristics may, on an individual level, contribute to this susceptibility. More specifically, if the likelihood of victimization would significantly increase with the presence (or absence) of specific combinations of personal characteristics, this could indicate individual differences in susceptibility to aggressive and/or intimidating approaches. However, although some factors that are associated with victimization (e.g. in the context of IPV or CSE) have previously been reported, a method to quantify the cumulative contribution of specific combinations of personal characteristics to the likelihood of victimization on an individual level is, to the best of our knowledge, lacking. The present study, therefore, set out to develop a first probability framework in an effort to quantify individual susceptibility to victimization by means of aggressive and/or intimidating approaches.

Studies that have identified factors associated with victimization seem to primarily, although not exclusively, originate from the fields of IPV or CSE, and generally focus on female victims. IPV is characterized as any behaviour within an intimate relationship that causes physical, psychological, or sexual harm (World Health Organization & Pan American Health Organization, 2012). Commercial sexual activity is defined by the Trafficking Victims Protection Act as ‘any sex act on account of which anything of value is given to or received by any person’ (Trafficking Victims Protection Act, 2000). CSE takes place when ‘a minor is involved in commercial sexual activity, or an adult is forced, tricked, or coerced into commercial

sexual activity' (Reid & Piquero, 2014). It manifests in several forms, such as abuse through sex trafficking, abuse through prostitution, and abuse through pornography (Chase & Statham, 2005; Hughes, 1999). As stated above, although aggressive and/or intimidating interpersonal approaches appear instrumental in this context, a remarkable interindividual heterogeneity in the receptivity to such approaches is reported (e.g. Capaldi et al., 2012; McClain & Garrity, 2011; Pereira et al., 2020). It remains undetermined, however, which specific circumstantial, contextual, developmental, and individual factors (e.g. deviant peers, low socioeconomic status background, academic underachievement, and/or youth psychological trauma) may combine to increase the likelihood of becoming victimized.

1.1. Potential differentiation in trajectories leading to victimization

There may be some nuance in how clusters of personal characteristics may contribute to a heightened susceptibility to aggression and/or intimidation, and the subsequent increased likelihood of victimization (e.g. of relatively young females in the context of IPV/CSE). Previous studies suggest that aggressive and/or intimidating approaches (applied by any perpetrator) can potentially be distinguished by proportionally more physical or primarily non-physical properties. According to Kaye and Erdley (2011), physical intimidation communicates the actual or suggested intention to physically injure someone, whereas verbal aggressiveness is typically characterized by menacing, scrutinizing, yelling, and gaslighting (Lee & Lincoln, 2017; Sweet, 2019). Non-verbal aggressiveness is distinguished by social isolation, such as gossiping behind the person's back, and ignoring and/or intentionally excluding someone from social networks or peer groups (Archer & Coyne, 2005). Lastly, sexual intimidation can be performed physically (groping, inappropriate touching) and/or verbally (i.e. verbally expressing sexual intentions) (Gruber, 1992), and appears to be applicable to online strategies as well (e.g. sexting, sextortion, grooming, creation and distribution of sexually abusive materials) (Mori et al., 2020; Radford et al., 2020; Wolak et al., 2018). Summarizing, the literature on interpersonal aggressive and/or intimidating approaches does seem to differentiate between physical, verbal, non-verbal, and sexual aggressive/intimidating features, which can all potentially (and not rarely in conjunction) contribute to victimization. However, in relation to their potential effectiveness, it is hypothesized that they are actually associated with distinctive clusters of personal characteristics in potential victims. Therefore, it seems necessary from a methodological perspective to take all four features into account.

1.2. Previously identified characteristics contributing to IPV/CSE victimization

Previous studies have investigated psychological factors that potentially contribute to the susceptibility to aggressive and/or intimidating approaches (e.g. Casassa et al., 2021; Preble, 2021). However, these studies generally focus on singular relationships between (hypothesized) susceptibility factors and outcomes (e.g. established IPV/CSE victimization). More specifically, while victimization of the four features of aggressive and/or intimidating approaches is mentioned within the literature, the way in which these susceptibility factors cluster around these approaches and account for the overall outcome of established victimization is not taken into account. Therefore, there may be an underlying variable of susceptibility to aggression/intimidation that is associated with victimization by aggressive/intimidating approaches, and consequently the likelihood of victimization (e.g. in the context of IPV/CSE). Nevertheless, a significant number of characteristics have been associated with eventual victimization in the context of IPV/CSE in previous studies; for example, (light) intellectual disability, lack of adequate emotion regulation, impulse control deficiencies, risk-taking behaviour, substance abuse and dependency, and attention deficit hyperactivity disorder (ADHD) (Gover, 2004; Verwijs et al., 2011; Vézina & Hébert, 2007; Walsh et al., 2012; White & Buehler, 2012). In fact, many of these factors, in addition to their reported individual effects, seem to be strongly related to or associated with each other (e.g. Bernardi et al., 2012; Khurana et al., 2012; Pulay et al., 2009; Shaw et al., 2014; White & Buehler, 2012). In addition to these psychological factors, several social–emotional (developmental) factors and childhood adverse events seem to contribute more or less independently to a higher probability of becoming victimized. Reported examples are a violent home environment during childhood, childhood (sexual and/or physical) abuse, lower friendship quality, lower self-esteem, loneliness, anxiety, and symptoms of depression (Lalor & McElvaney, 2010; Orth et al., 2009; Vanhalst et al., 2014; Verwijs et al., 2011; Vicary et al., 1995).

More subtle or indirect factors that are reported in relation to IPV/CSE victims include structural misjudgement of potentially dangerous situations and sensation seeking (e.g. having unprotected sex, shoplifting, and carrying weapons) (Marret & Choo, 2017; Messman-Moore et al., 2010; Russell et al., 2010). Sensation seeking in itself seems to be enhanced by factors such as drug abuse (McKay et al., 2017), having risk-taking peers (Perez, 2016), and being in an unstructured home situation (Van

den Borne & Kloosterboer, 2005; Verwijs et al., 2011). Moreover, although an important transdiagnostic factor, childhood maltreatment seems specifically related to the development of borderline personality disorder (BPD) (Herzog et al., 2022). BPD, in turn, is additionally related to indirect factors such as problematic, high-risk, and impulsive behaviour.

In sum, several factors have been directly or indirectly associated with victimization in the context of IPV/CSE. Their combined effect suggests a network of mutually interacting factors, traits, and characteristics that may produce an increased susceptibility to aggression/intimidation and consequently a higher likelihood of victimization for any given individual (McClain & Garrity, 2011). Lastly, there is reason to believe that the susceptibilities contributing to the likelihood of victimization actually cluster around yet unidentified though differential forms of aggressive and/or intimidating approaches (potentially being primarily physical, verbal, non-verbal, and/or sexual) that may, at least partly, account for the heterogeneous constitution of reported victim populations.

1.3. Aim of the present study

In the present study, a Bayesian belief network is constructed, incorporating data from previous studies to investigate the multivariate contribution of previously identified factors to victimization following aggressive and/or intimidating approaches. It is hypothesized that the probability of victimization in this context either increases or decreases with specific combinations of factors that are associated with a susceptibility to aggressive and/or intimidating approaches, which manifests itself potentially through distinctive (physically violent, sexual, verbally aggressive, or non-verbal) features of aggression and/or intimidation.

2. Methods

2.1. Bayesian belief networks

A Bayesian belief network was created on an expansive body of literature to catch the proportional contribution of (personality) factors associated with victimization by aggressive and/or intimidating approaches. A Bayesian belief network is a probabilistic graphical model represented by a directed acyclic graph. In this graph, variables are modelled as the nodes of the graph (Figure 1). A node can have two or more states with an associated probability that the node is in a specific state. The edges between the nodes represent conditional dependencies.

Bayesian networks create the possibility of mathematically estimating the quantitative contributions of various independent variables to the likelihood of occurrence of a defined outcome (Lauritzen & Spiegelhalter, 1988). Technically, Bayesian networks use Bayes' theorem (Equation 1) to combine prior knowledge $p(B)$, conditional dependencies $p(E|B)$, and observed data $p(E)$ to calculate the posterior probability of a certain event given the observed data (Etz & Vandekerckhove, 2018; Wagenmakers et al., 2016). Bayes' theorem allows us to update the posterior probability $p(B|E)$ when new information is obtained. With inference, Bayes' theorem is used to update probabilities based on the entered evidence. An introduction to Bayesian inference for psychology, including some applied examples of the theorem, can

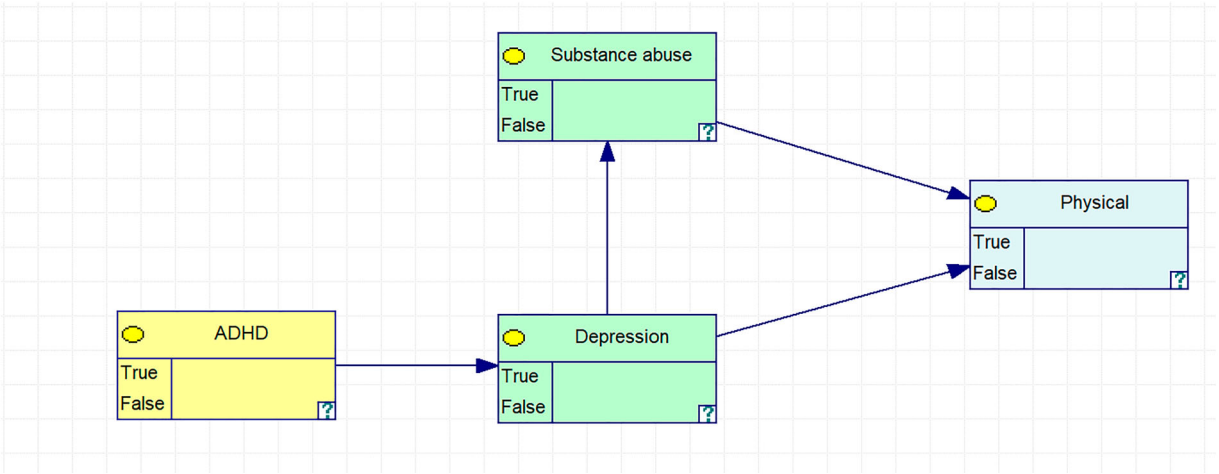

Figure 1. Example of a four-part Bayesian network, using part of the model developed in the current study: consisting of the factors attention deficit hyperactivity disorder (ADHD), depression, substance abuse, and physical. The latter is the outcome of the depicted model. Here, 'ADHD' influences 'Depression'. Depression influences both 'Substance abuse' and 'Physical', while Substance abuse itself also influences Physical. In this example, each node has two states: 'True' (being apparent) or 'False' (being absent). Physical = physically violent aggressive approaches.

be found in Etz and Vandekerckhove (2018).

$$p(B|E) = \frac{p(E|B)*p(B)}{p(E)} \quad (1)$$

In the example network (Figure 1), evidence about depression (e.g. if 'true') updates the posterior probability of ADHD being true (i.e. being apparent). To illustrate this, assume the following probabilities for the relationship between ADHD, depression, and substance abuse:

$$p(ADHD = True) = 0.02$$

$$p(Depression = True|ADHD = True) = 0.2$$

$$p(Depression = True|ADHD = False) = 0.14$$

$$p(Substance\ abuse = True|Depression = False) = 0.33$$

$$p(Substance\ abuse = True|Depression = False) = 0.3$$

These are model inputs. Then, the prior probability of depression being true depends only on its parent, ADHD, and is therefore equal to $0.02 * 0.2 + 0.98*0.14 = 0.141$. However, when it is known that someone is not depressive, this evidence is entered in the model. Now,

$$p(Depression = False|ADHD = True) = 1 - 0.2 = 0.8$$

$$p(ADHD = False) = 1 - 0.02 = 0.98$$

$$p(Depression = False|ADHD = False) = 1 - 0.14 = 0.86$$

$$p(ADHD = True|Depression = False) = p(Depression = False|ADHD = True)*\frac{p(ADHD = True)}{p(Depression = False)}$$

$$= \frac{p(Depression = False|ADHD = True)*p(ADHD = True)}{p(Depression = False|ADHD = True)*p(ADHD = True) + p(Depression = False|ADHD = False)*p(ADHD = False)}$$

$$= 0.8*\frac{0.02}{(0.8*0.02 + 0.86*0.98)} = 0.019$$

The probability of substance abuse follows directly via inference: $P(Substance\ abuse = True|Depression = False) = 0.33$. For the inference of probabilities in a more complex model, we used GeNIe Modeler (BayesFusion, LLC, 2019b). In the developed model, the probability of victimization by aggressive and/or intimidating approaches can be quantified based on either the presence or absence of combinations of predefined circumstantial, contextual, developmental, and/or individual factors.

Added information propagates throughout the network. For example, within the network in Figure 1, the node 'Physical' is not only directed influenced by depression, but also indirectly influenced by depression via substance abuse. Furthermore, the node 'Physical' is only indirectly influenced by ADHD. The propagation of information throughout the network can be obtained by calculating a joint probability. The larger the network, the more a node can be influenced by previous nodes, and the more complex this joint probability becomes. However, as the dependency between two nodes is only through another node (as in Figure 1, dependency between ADHD on one hand and substance abuse on the other is only through depression), this means that if the value of the intermediate node (depression) is known, the posterior probability of the physical node can be calculated independently of the value of ADHD. Therefore, the required model data are limited to the prior probabilities of (parent) nodes and the conditional probabilities on the edges.

It must be noted that in the Bayesian network in Figure 1, the nodes describe characteristics of an individual at a certain time of interest, and therefore no temporality is included in the model. However, it is possible to create time-dependent Bayesian networks in which characteristics have an influence on other characteristics at a later time.

2.2. Building the Bayesian network

For inclusion in a Bayesian belief network, generally reported statistics such as odds ratios, interquartile ranges, and prevalence have to be converted into conditional probabilities. After inclusion in the Bayesian belief network, such a network – as opposed to, for example, a meta-analysis – provides instantly interpretable and generalizable results on multivariate interaction effects, rather than just determining which factors are (typically independently) involved in relation to a specified outcome. Moreover, an important advantage of this method is that it can combine different types of (published) data from different sources and does not require raw data from one database, which makes it robust for missing data (Druzdzel & Díez, 2003; Uusitalo, 2007). Finally, the dynamic aspect of the Bayesian model makes it possible to immediately update it with new information when it becomes available and to directly display its effect on the calculated probabilities and associated variables (Tang et al., 2019). Although a Bayesian model does

not necessarily imply causality (Pearl, 2009, p. 21), the model can be interpreted bidirectionally. This provides the significant advantage that when, in this case, victimization by aggressive and/or intimidating approaches has been established, the model automatically generates the probabilities for specific (personal or contextual) factors being in play. This presents the opportunity to design effective, (personalized) intervention policies; for instance, improving the resilience of highly susceptible individuals by intervening on apparent (combined) characteristics that have the greatest effect on the likelihood of becoming victimized by the aggressive/intimidating approaches outcome.

Ideally, conditional probabilities can be obtained directly from published data. However, when source data are unknown, usually the statistics must be transformed into conditional probabilities via calculation, simulation, or inference. This depends on the information provided in the article (e.g. group sizes, type of statistics). Risk and odds ratios, for example, can be translated into conditional probabilities using the Bayes factor ('calculation'). Contingency tables can be directly translated into conditional probabilities. Other statistics, such as correlations, can be transformed into conditional probabilities using simulation, based on the correlation between the two factors, and the group sizes and/or percentages of at least one of the factors. With Monte Carlo simulation, correlated variables were drawn with the required proportions. The outcome was translated into a contingency table, which was subsequently translated into conditional probabilities. If a paper provided insufficient information on group sizes or proportions, for example, a best estimate was based on priors resulting from adjacent nodes and edges in the network ('inference'). In the Bayesian model, we included only effects that were considered statistically significant in the article that described this effect.

An overview of the usable statistics for a Bayesian network can be found in Appendix A. No additional efforts were conducted to calculate meta-data from multiple studies on specific variables, owing to the complexity of combining the data into one variable and conditional probabilities. For this reason, for articles that both were suitable for implementation in the model and described the same associations/relationships (e.g. between ADHD and depression), the article with the largest sample size and most recent publication year was used for creating the Bayesian belief network (IC7).

2.3. Dependent and independent variables

In the current study, independent variables are individual factors (associated with personality, self-regulation, and socioemotional development) and contextual factors (primarily related to exposure to trauma/violence). The dependent variables are identified as victimization by either physically violent, sexual, verbally aggressive, or non-verbal aggressive and/or intimidating approaches (Archer & Coyne, 2005; De Wit et al., 2022; Gruber, 1992; Kaye & Erdley, 2011; Lee & Lincoln, 2017; Sweet, 2019).

2.4. Information sources and search strategy

The search and selection process to identify the studies eligible for the proposed Bayesian probabilistic model followed a three-step strategy. First, our research interest originated from specific challenges identified by public prosecution, governance, and associated mental health and social institutions, expressed in a significant concern related to CSE and 'grooming'. In doing so, an initial broader search strategy was applied to select the independent and dependent variables based on reports and peer-reviewed articles. For each of these determined core concepts, multiple synonyms were created (e.g. intimidation and harassment) and manually combined as search terms for the systematic literature search. Secondly, this systematic literature search was performed, based on Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, while taking the methodological requirements associated with Bayesian modelling into account. More specifically, as the construction of a Bayesian belief network was the overall aim of the present study, studies providing eligible statistics (for implementation in a Bayesian network; see Section 2.2) were prioritized and literature reviews, for example, were excluded. Thirdly, the articles and their useful considered statistics were organized in a table from which these values were used to calculate the conditional probabilities to build the Bayesian model. This literature search was carried out between February 2019 and June 2019 and applied on the databases Google Scholar, ScienceDirect, Scopus, and PubMed. An overview of the terms used can be found in Appendix B. Following this, the reference lists of the studies were manually searched for additional and potentially relevant literature. Given the background of most studies and to ensure sufficient homogeneity in the statistics that would be incorporated in the eventual model, the literature search was focused on female victims in the age range 12–24 years (Verwijs et al., 2011).

2.5. Inclusion criteria and exclusion criteria

With the aim of including only relevant, reliable, and useful published statistics in the Bayesian network, specific inclusion and exclusion criteria were established. These consist of general criteria and strict

methodological requirements associated with creating a Bayesian belief network.

For a complete overview of the inclusion and exclusion criteria, see Tables 1 and 2.

An exception was made for studies that investigated (psychiatric/personality) disorders and related traits [e.g. narcissistic personality disorder (NPD) or BPD]. More specifically, the selection process was more tolerant for those studies regarding age and psychiatric samples. For instance, in the case of BPD, as children are typically not diagnosed with personality disorders such as BPD, there are no studies that investigate minors with a BPD diagnosis. Instead, articles that investigate personality disorder traits were used. Borderline personality traits in childhood have been found to be predictive of BPD symptoms and diagnosis in adulthood (Winograd, Cohen & Chen 2008). Therefore, studies using adult samples with a BPD diagnosis were not excluded.

Finally, while constructing the model, it appeared that relevant statistics for specific features in the network were still lacking (e.g. quantifying edges with distinct aggressive approaches, such as verbal versus physical). Therefore, additional search terms (in the context of bullying and sexual abuse) were used (see Table 1, IC8). With these statistics, the network could be adequately completed.

2.6. Data collection and selection process

To develop the Bayesian belief network model, the scientific papers had to report statistics that were suitable to be incorporated. To find these studies, the systematic literature review was carried out in two phases. First, titles and abstracts were reviewed for their relevance for the current study, using the above-mentioned inclusion and exclusion criteria. Thereafter, the full texts of the potentially relevant studies

Table 1. Overview of inclusion criteria.

Inclusion criteria	Type of inclusion criteria
IC1: The study is written in English	General
IC2: The full text of the study is available	General
IC3: The study should have a gender-mixed or female-only sample	General
IC4: The study comprises a sample of a Western population	General
IC5a: The study should have a sample with a mean/median age between 12 and 24 years of age OR IC5b: The study should be a population study that could be used in Bayesian network calculations as priors (see Section 2.2)	General (IC5a) OR Specifically for creating Bayesian network (IC5b)
IC6: The study should report statistics suitable for creating Bayesian networks (see Section 2.2)	Specifically for creating Bayesian network
IC7: If two studies both appear suitable for implementation in the model and describe the same associations/relationships, the article with the larger sample size and more recent publication year was used for creating the Bayesian network	Specifically for creating Bayesian network
IC8: The sample study (not population study) that is associated with victimization by aggressive and/or intimidating approaches is within the context of IPV, CSE, bullying, or sexual abuse[a]	Specifically for creating Bayesian network. To find appropriate statistics for some specific features in the network, the literature search had to be extended to aggressive/intimidating approaches in the context of bullying and sexual abuse

Note: The applied inclusion criteria comprised six general inclusion criteria and four inclusion criteria that were specifically associated with the requirements for Bayesian statistics.
[a]Online bullying/victimization is not included as an inclusion criterion.

Table 2. Overview of exclusion criteria.

Exclusion criteria	Type of exclusion criteria
EX1: The study consists only of men	General
EX2: The study consists of a non-Western population	General
EX3: The terms and definitions within the study are not in line with our terms (as mentioned in Appendix B)	General
EX4: The study is associated with different types of contexts in which victimization by aggressive and/or intimidating approaches occurs	General
EX5: The study is a review or meta-analysis	Specifically for creating Bayesian network
EX6: The study consists of a joint sample[a]	Specifically for creating Bayesian network
EX7: The study only reports statistics that are not suitable for creating Bayesian networks	Specifically for creating Bayesian network
EX8: The study provides an unreliable method and/or prevalences	Specifically for creating Bayesian network
EX9: The results of the study have too high or too low a specificity	Specifically for creating Bayesian network
EX10: The study had difficult-to-interpret data and/or methods	Specifically for creating Bayesian network

Note: The applied exclusion criteria comprised four general exclusion criteria and six exclusion criteria that were associated with Bayesian (methodological) requirements. [a]A joint probability comes out of the data, which makes the calculations of the conditional probabilities more complex. For example, a study that looks at an association between substance abuse and impulsivity within a sample with severe delinquency becomes p(SA|severe delinquency, impulsivity) instead of p(SA|impulsivity).

were carefully examined to decide whether they should be included in this study. If the reported statistics were considered useful for incorporation within the Bayesian network (see Sections 2.2 and 2.5) and the papers also met the other criteria, the articles and their relevant statistics were organized in a table, from which these values were used to calculate the conditional probabilities to build the model. Two researchers (authors KdW and MB) independently performed this data collection and selection process, following the protocol and using the same search terms and criteria. To the best of their abilities, they avoided studies with possible sampling biases and confounding factors. The researchers discussed and compared their findings. Discrepancies were resolved by discussion and joint consensus.

2.7. Validating the model

The reliability of the Bayesian network depends on the quality of the included data (Druzdzel & van der Gaag, 1995; Kwan et al., 2011) and the structure of the network. If the quality of the model data is too low, this will result in an inaccurate posterior. An unstable posterior output that is highly sensitive to changes in the model data could therefore be a consequence. Sensitivity analysis is a common way to measure the effect of inaccuracies in the model parameters on the output, and can support the development of a model in which the output is robust for inaccuracies in input data. A robust model will show an absence of the strong alterations when small changes in the input data are applied. To measure the sensitivity of the model, we used the sensitivity analysis module of GeNIe (Bayesfusion, LLC, 2019a, 2019b), which uses a Bayesian network sensitivity measure proposed by Kjærulff and van der Gaag (2000) and Kwan et al. (2011). Finally, the contribution of each specific factor on the likelihood of victimization by the four specific features of aggressive and/or intimidating approaches was calculated. (For further explanation, see Appendix C.)

3. Results

3.1. Included literature and data

In total, 66 studies were identified as being potentially relevant for the current study. From these articles, 15 were excluded because they had unusable samples (e.g. mainly non-Western sample, sample consisting only of males) or because they were reviews or meta-analyses. Moreover, 27 articles were excluded owing to their data being unusable for Bayesian networking. As one factor is conditioned upon another, suitable statistics are needed to transform the values in the article into conditional probabilities. This means, for example, that when only one of the two factors within the named association/relationship contains sufficient information (i.e. prior knowledge, observed data, and/or likelihood), no conditional probabilities can be calculated, and the data cannot be used for the Bayesian network. In addition, it must be possible to separate the effects in statistics and examine each factor separately (e.g. separate beta values have been described for different factors). Logistic regressions are, for example usable, while hierarchical logistic regressions could not be incorporated as the articles mostly mentioned inseparable interactions.

Of the 24 studies that remained, 12 were excluded, for the following reasons: having unreliable prevalence or using unreliable methods or difficult-to-interpret data and/or methods ($n = 2$), e.g. significantly conflicting statistics compared to other publications (Sjöwall et al., 2013); not being in line with our terms, as mentioned in Appendix B ($n = 1$) (Cloninger et al., 1988); the specificity of results being too high or too low ($n = 5$), e.g. subdivision of delinquent behaviour (Rigby & Cox, 1996); being associated with different types of context in which victimization by aggressive and/or intimidating approaches occurs ($n = 2$), e.g. cyberbullying victimization (Hemphill & Heerde, 2014); or being suitable for implementation, but describing the same associations/relationships (IC7; $n = 2$) (e.g. Scarpa et al., 2010). This left 12 papers of sufficient quality to develop the model (Figure 2; Tables D1–D3 in Appendix D). All incorporated studies consequently included data from at least 112 subjects (the largest being 34,653 subjects from studies that used NESARC data: Bernardi et al., 2012; Stinson et al., 2008).

3.2. The Bayesian model for victimization by aggressive and/or intimidating approaches

The selection and methodological strategy provided a network consisting of 14 risk factors (three contextual factors and 11 individual factors) loading on four distinctive features (physical, verbal, sexual, and non-verbal aggression and/or intimidation) being associated with the likelihood of victimization in the context of IPV, bullying, sexual abuse, and/or exploitation (Figure 3). Our efforts resulted in a quite dense network with a high degree of interconnectedness between the implemented factors. This provided a very dynamic model: if, on an individual level, specific characteristics are reported as either 'present' or 'absent', probability outcomes all over the network may be influenced either directly or much more subtly. More specifically, if, for example, in an identified victim, next to other characteristics, a history of childhood physical abuse is established, this directly increases the likelihood of victimization by sexual intimidating approaches. In addition, the model suggests that it also contributes more subtly to an increased

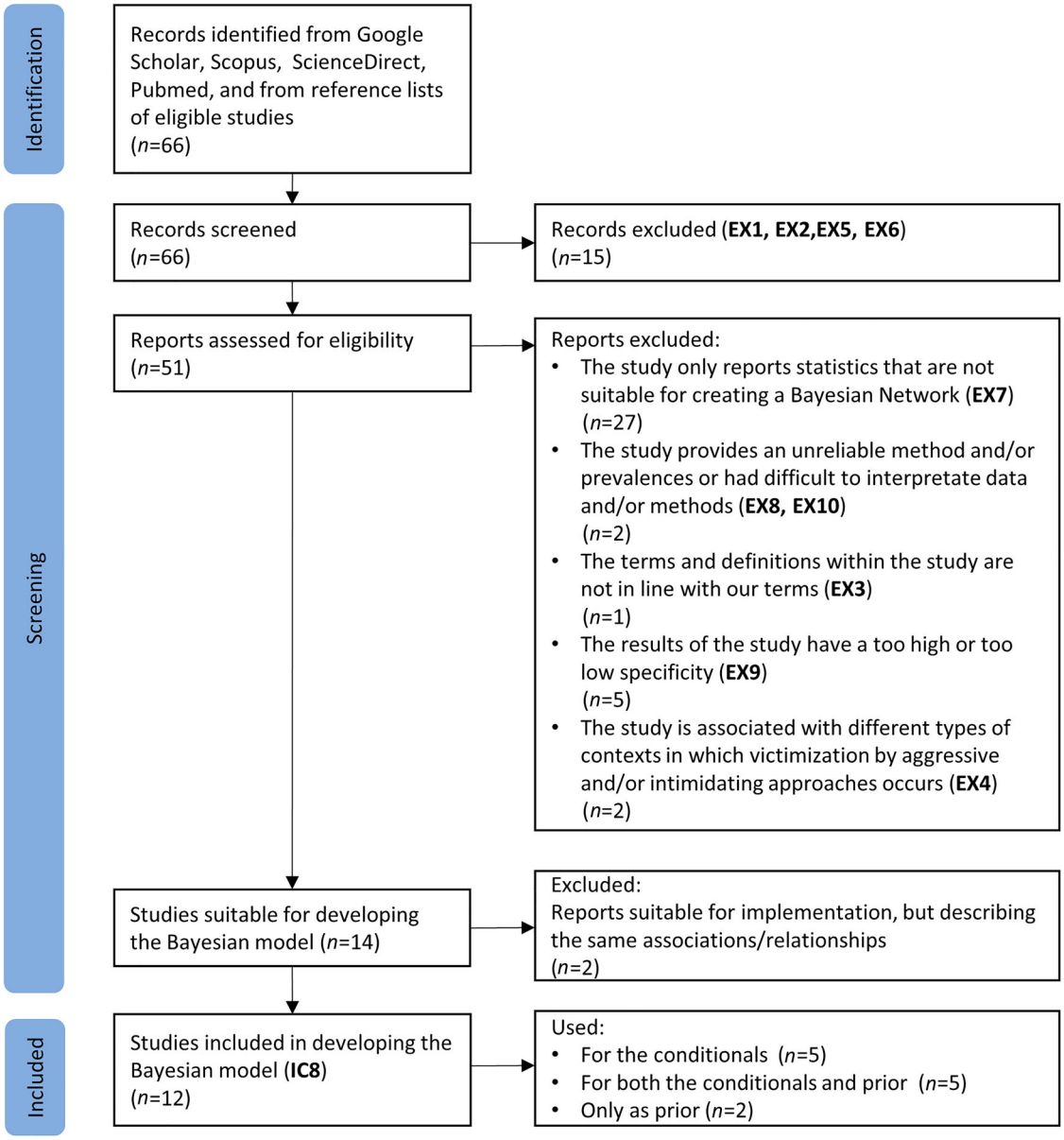

Figure 2. Overview of considered studies and reasons for exclusion. The flow diagram shows the identification, screening, and inclusion process, leading from 66 identified studies to excluding 52 based on the exclusion criteria. Fourteen studies were considered suitable for developing the Bayesian model. Two reports were considered suitable for implementation, but described the same associations or relationships and were therefore excluded, leading to a total of 12 studies eventually included in the development of the Bayesian model.

likelihood of victimization by physically violent approaches (via its associations with ADHD).

An additional advantage of the model is that if information about a specific factor state is lacking, it is still possible to provide the probabilities for one or multiple parameters using population prevalence for the missing data. For example, the prevalence of ADHD in the general population is 2%, as reported by Tuithof et al. (2014). This means that if there is no information about the presence of ADHD in an individual case, the present model adopts the probability statistic of 2% for its calculations. This makes the applied method relatively tolerant for missing data in the context of assessment and/or policy advice.

Finally, the sensitivity analyses for the four aggressive/intimidating approaches indicated for all potential combinations of factors, the derivate value ranged from 0.02 to 0.64 for physical aggression, from 0.04 to 0.79 for both verbal non-verbal aggressiveness, and from 0.07 to 0.53 for sexual. All are well below 1.0, indicating a fairly robust model.

3.3. Influence of the individual factors on the estimated likelihood of victimization by aggressive and/or intimidating approaches

From the literature, it may be concluded that aggressive and/or intimidating approaches might be classified based on primarily physical and non-

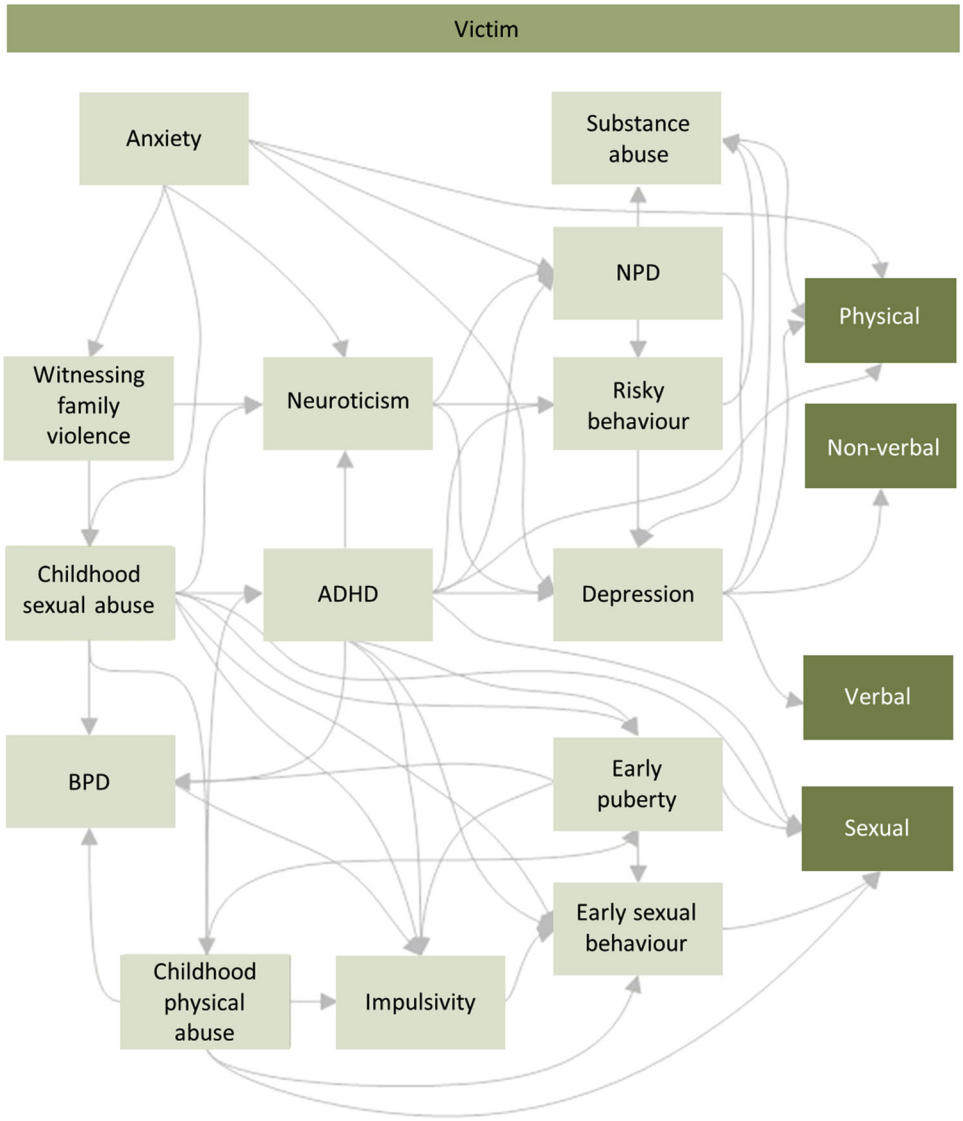

Figure 3. Overview of the 'victimization by aggressive and/or intimidating approaches' model: the created Bayesian belief network, displaying a dense network with a high degree of interconnectedness between the implemented factors. The dark green nodes are the outcome nodes, representing the likelihood of becoming victimized by any one of the four aggressive and/or intimidating approaches. The implemented individual and contextual factors are represented by the light green nodes. The arcs represent statistical relationships/associations between the nodes. NPD = narcissistic personality disorder; ADHD = attention deficit hyperactivity disorder; BPD = borderline personality disorder.

physical properties, which can be subdivided into four features: physically violent, sexual, verbally aggressive, and non-verbal. However, because our analyses indicated that the involved risk factors and the strength of their influence on the outcome of verbal and non-verbal approaches were close to identical, these aggressive and/or intimidating approaches are, from this point, combined as non-physical approaches. Following this, the contribution of each individual factor to the three defined outcome variables (physical, non-physical, and sexual intimidation) was calculated.

It appeared that within the present model, depression (14%) and substance abuse (13%) were the strongest contributors to the likelihood of victimization by physically violent approaches, followed by neuroticism (3%) and risky behaviour (2%) (Figure 4). Childhood sexual abuse (17%) was the most prominent factor associated with the likelihood of victimization by sexual intimidating approaches, followed by early puberty (13%), ADHD (13%), childhood physical abuse (12%), and early sexual behaviour (12%). Depression (34%) convincingly contributed to the probability of being victimized by non-physical approaches. Other contributory factors were neuroticism (8%), childhood sexual abuse (2%), and traits associated with NPD (1.5%). See Figure 4 for all risk factors contributing to victimization by aggressive and/or intimidating approaches.

4. Discussion

Victimization can hypothetically be associated with an inherent susceptibility to aggressive and/or intimidating approaches. Indeed, because of the typical

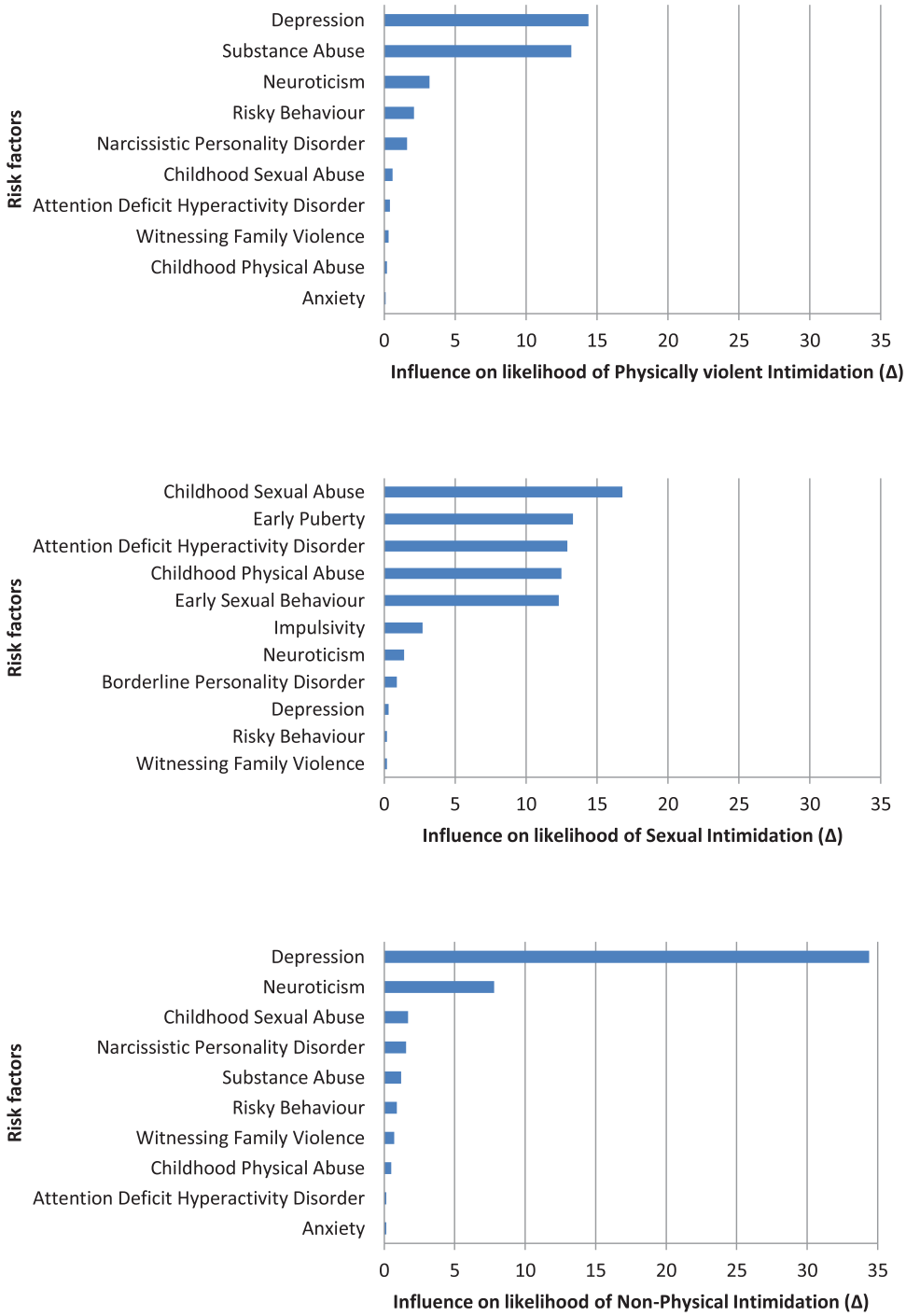

Figure 4. Influence of potential risk factors on the likelihood of becoming victimized by aggressive and/or intimidating approaches. Three separate graphs show the influence of the potential risk factors on the likelihood of victimization by physically violent, sexual, and non-physical aggressive and/or intimidating approaches, respectively. The influence on the likelihood of becoming victimized by aggressive and/or intimidating approaches is calculated by the difference of the estimated likelihood of victimization by aggressive and/or intimidating approaches between the factor of interest being apparent and being absent. All other factors were placed in a neutral state. (A) All the individual factors for predicting victimization by physically violent approaches. (B) All the factors for making a prognosis of victimization by sexual intimidating approaches. (C) All the factors predicting victimization by non-physical approaches (being verbally aggressive and non-verbal aggressiveness).

application of these aggressive and/or intimidating approaches in IPV, bullying, sexual abuse, or CSE, they may be considered as being instrumental in victimization and/or sustained coercion in this context (e.g. Casassa et al., 2021; Iglesias-Rios et al., 2020). However, it seems likely that within the same context, differences in this likelihood can, at least to some extent, be attributed to interindividual differences in the susceptibility to aggressive and/or intimidating approaches. A better understanding of how victimization originates, and how susceptibility to aggressive and/or intimidating approaches works, should help

us to develop effective counterstrategies, for example based on prevention and the development of resilience, and/or adequate treatment and support formats. Therefore, the present study set out to investigate how the circumstantial, contextual, developmental, and individual characteristics of victims may relate to the likelihood of becoming victimized by specific aggressive and/or intimidating approaches (physically violent, sexual, or non-physical). Although previous studies have investigated many factors and the ways in which they potentially contribute to victimization, the present study is, to our knowledge, the first to investigate and attempt to quantify the mutual interactions of victim characteristics in relation to the likelihood of victimization by aggressive and/or intimidating approaches. To achieve this, a Bayesian belief network was developed based on previously published statistics associated with victimization in the context of, primarily, IPV, bullying, and/or sexual abuse. Accordingly, based on a network of mutually interacting factors, traits, and characteristics, it indeed appeared possible to estimate the likelihood of established victimization through effectively used aggressive and/or intimidating approaches. It could be hypothesized that the differences in (probability) outcomes, based on distinct clusters of individual characteristics, may be indicative of a susceptibility to aggression/intimidation (either in general, or of a specified nature), because, in addition, we found that the trajectories leading to eventual established victimization clearly followed statistically distinct routes that could be classified as physically violent, sexual, or non-physical aggressive and/or intimidating approaches.

With respect to the identified individual factors, childhood sexual abuse, early puberty, (symptoms of) ADHD, childhood physical abuse, and early sexual behaviour were shown to have the strongest influence on the likelihood of becoming victimized by sexual intimidation. Based on the present data, depression, neuroticism, NPD traits, and substance abuse may all be considered to contribute, to some extent, to the likelihood of being victimized by physically violent and non-physical intimidating approaches. Indeed, the risk factors that contribute to the likelihood of victimization by these two types of approaches appear to resemble each other, although differing in statistical strength, signifying some discriminatory potential. In the present model, substance abuse contributed distinctively to victimization by physically violent approaches, while depression seemed to be more strongly related to the likelihood of being victimized by non-physical approaches.

Although some general factors, such as social and or financial problems, are typically associated with adverse outcomes and the likelihood of either IPV or CSE victimization (Luna et al., 2014; Thapar et al., 2015), a more specific overview of high-risk factors associated with well-defined intimidation techniques could be provided based on the present findings. Social–emotional (developmental) factors (e.g. anxiety and depressive symptoms) and childhood adverse events (e.g. history of childhood sexual/physical abuse and witnessing family violence) seem to be of relevance in an individual becoming vulnerable to aggressive and/or intimidating approaches in general. Nevertheless, the present results provide considerable evidence that other characteristics seem to be more discriminatory in relation to the individual susceptibility to more specific forms of intimidation. Based on the present model, it may be concluded that childhood physical abuse and symptoms of ADHD may contribute to the susceptibility to becoming victimized by sexual intimidation, whereas risky behaviour and neuroticism contribute to an increased likelihood of being effectively intimidated by either physically violent or verbally aggressive intimidation techniques. In that perspective, the association between depression and victimization by non-physical intimidation may be considered to be a significant finding. Other factors, however, although reported in earlier studies, appeared to be statistically less relevant: in the present model, witnessing family violence had, for example, a remarkably low impact on susceptibility (average likely contribution of 0.4%).

It appeared that characteristics such as impulsivity, early sexual behaviour, early puberty, and BPD traits are discriminant factors for becoming vulnerable to sexual intimidation. The influence of these more or less externalizing behaviours seems to be consistent with the previous literature. Borderline personality symptoms, including transdiagnostic constructs such as emotional dysregulation and impulsive behaviours, often co-occur with conduct problems such as aggression, rule-breaking behaviour, lying, and disobedience (Hill, 2015; Scott, 2015). All of these factors appear to be associated with sexual victimization (Fergusson & Woodward, 2000; Iverson et al., 2014; Messman-Moore et al., 2010; Sansone et al., 2008). The impulsivity and sensation-seeking behaviour associated with BPD increase a person's engagement in risky behaviours, such as criminal behaviour, reckless driving, and substance use. Especially relevant in this context may be the increased engagement in risky sexual behaviours, which appears to be a risk factor for sexual victimization as well (Messman-Moore et al., 2010; Walsh et al., 2012). For instance, adolescent girls with ADHD symptoms were at higher risk of engagement in risky sexual behaviours and therefore sexual victimization (White & Buehler, 2012). Previous research suggests that this is a result of impaired cognitive and emotional mechanisms, subsequently making them less capable of recognizing or responding appropriately to risky situations. However, in our model, risky behaviour does not appear to be directly

associated with victimization by any form of intimidation. Instead, it seems to have only marginal effects on victimization through interaction effects with other factors. This finding appears to be slightly contradictory to previous scientific studies indicating it as an important risk factor in this context (Gover, 2004; Lalor & McElvaney, 2010; Messman-Moore et al., 2010; White & Buehler, 2012). This may, to some extent, be related to the lack of data that could be found on the relationships with other features (e.g. impulsivity and traits associated with BPD) and victimization by sexual intimidation, associated with IPV and CSE. However, this methodological shortcoming is relatively speculative and therefore more research would be useful to further investigate the proportional contribution of, among other factors, risk-seeking behaviours.

4.1. The latent variable 'susceptibility to aggression and intimidation'

In addition to providing more insights into the combined contribution of known factors associated with victimization by aggression and/or intimidation, e.g. in the context of IPV and/or CSE), the present scientific effort and resulting model highlight another hypothesis: the distribution in probability statistics based on combinations of different factors being either 'present' or 'absent' in individual cases suggests that there could be fundamental interindividual differences in the susceptibility to aggressive and/or intimidating approaches. More specifically, in the same (subversive or threatening) context, not every individual appears to be equally likely to become a victim of aggressive and/or intimidating approaches, either in general or in a more specific form (i.e. physical, non-physical, sexual). It may thus be concluded that the variance in (victimization) outcomes could, at least partly, be explained by interindividual differences in the susceptibility to aggression/intimidation; a susceptibility that is likely to be associated with the interindividual differences in personal characteristics and their reciprocal dynamics. In relation to the present findings, it could well be a latent variable mediating between the implemented factors and the overall outcome, being victimization primarily in the context of IPV, sexual abuse, bullying, or CSE. From that perspective, the present model may be considered an initial outline to effectively indicate susceptibility to aggressive and/or intimidating approaches. Nevertheless, more research is needed to further unravel the subtleties associated with victimization, as a susceptibility to aggressive and/or intimidating approaches may partly explain victimization. For instance, becoming overwhelmed by aggressive and/or intimidating approaches requires a perpetrator who instigates the aggressive/intimidating approaches as well, as victimization is not possible without an individual carrying out those approaches. This may make intimidation a fundamentally interpersonal and reciprocal phenomenon. This emphasizes the relevance of research being conducted on perpetrator characteristics as well, as well as their interactions with the victim traits and vulnerabilities identified herein. The present study may be considered a useful stepping stone for such research.

4.2. Limitations

Although Bayesian belief networking is the most suitable method for creating an overview of the quantitative contribution of multiple factors and their interactions on the probability of becoming vulnerable to victimization by intimidation, it gives rise to some important limitations. The statistical requirements (e.g. odds ratios, interquartile range, or prevalences) were the most important limitation, as some literature does not necessarily provide these types of statistics. As a result, only 12 articles out of the 66 originally selected papers could be used for the construction of the model. Consequently, some factors that are regularly referred to in this context, such as emotional dysregulation, self-esteem, loneliness, and lack of social skills or adequate emotion recognition, did not make it into the present model (Verwijs et al., 2011; White & Buehler, 2012). In addition, as addressed, a factor such as risk-taking behaviours contributed to the model, but only marginally. Moreover, as the published statistics also considered cross-sectional data, it is not possible to determine causal relationships between factors over time based on the Bayesian model. Furthermore, to limit the complexity of the model, and owing to substantial differences in the prevalence of multiple risk factors across Western and non-Western populations (e.g. mental disorders) and cross-cultural differences in the presentation of factor and symptom expression (e.g. BPD) (Munson et al., 2022), we included only Western populations. Moreover, the data necessary for Bayesian networking appeared to be primarily reported within the literature on sexual abuse and bullying. Consequently, the starting point of the current study shifted from IPV- and CSE-related victimization to a model that is mostly built on bullying and sexual abuse data, with incidental data in the context of IPV. Nevertheless, we assume that the underlying dynamics associated with the effectiveness of aggressive and/or intimidating approaches is a generic phenomenon in which the same basic elements occur regardless of the context; these mutually interacting factors produce an increased susceptibility to aggressive and/or intimidating approaches and thus a higher likelihood of victimization. However, the literature focused on CSE that has usable data for Bayesian networks still seems to

be limited, and a validation of the model in the context of CSE victimization, or adding CSE-related data when provided in the literature, should be performed before strong conclusions can be drawn.

Indeed, while the Bayesian belief network has some limitations, it also has some relevant benefits. For example, a significant advantage may be that new data can efficiently be adopted in a Bayesian model, and with new data it should be possible to quickly update the present overview in the future. Furthermore, the disadvantages of the Bayesian belief network method do not seem to outweigh the advantages of using this approach for creating an instantly interpretable and generalizable overview on complicated multivariate interaction effects, rather than just determining which factors are (typically independently) involved in relation to a specified outcome. In addition, the dynamic aspect of the model can make it highly relevant for the development of effective (targeted) prevention, treatment, and resilience-building strategies against susceptibility to intimidation techniques.

To create the Bayesian belief network, a clear a priori classification was required on which the available data would be fitted. As far as intimidating attitudes and behaviours have been studied previously, such classification appears to be rather ambiguous: based on the literature, direct (physically violent, verbally aggressive) and indirect aggressive and/or intimidating approaches (e.g. Card et al., 2008) or physical and non-physical approaches are generally examined, with a relatively independent body of literature capturing sexual intimidation (associated with abuse, coercion, and/or cybercrime) (e.g. Bosson et al., 2015; DeGue & DiLillo, 2004; Outlaw, 2009; Parkhill & Abbey, 2008). Based on the definitions used in previous studies, the current study made an a priori classification of the features of aggressive and/or intimidating approaches that presumably precede the overall outcome of 'established victimization'; these physical and non-physical classified approaches can be subdivided into four features, namely physically violent, sexual, verbally aggressive, and non-verbal aggressive/intimidating approaches. This prerequisite for a predefined classification appeared to be accurate in organizing the existing statistics in an interpretable and useful way.

Lastly, the implemented data consist of both self-reports and interviewer-rated retrospective reports. These observer-rated data and self-reports may differ in their perception of victimization and, subsequently, the reported statistics; for example, see the difference in classification between Messman-Moore et al. (2010) and White and Buehler (2012). However, the implemented data appear to tend more towards covering relatively extreme cases. Subsequently, the results could be biased towards more severe cases of victimization. Whether the same features associated with intimidation, and the currently described interdependencies, are also related to less excessive appearances of victimization and/or more regular circumstances (e.g. during the performance of professional tasks) has yet to be investigated and proven. Furthermore, as previous studies have pointed out the potential biases and outcome discrepancies between those two types of data (e.g. Kaiser et al., 2022), it must be acknowledged that by implementing reported statistics from published studies, the present study is subject to outcomes based on diverse assessment methods (with the associated range in validity and reliability). If the present framework were to be used to further develop our insights into victim characteristics in the future, evaluating the assessment methods used in the included studies (along with the statistical requirements) might be something to take explicitly into consideration.

4.3. Future research directions

As indicated above, the present model should probably be regarded as the first framework to investigate the characteristics collectively contributing to the likelihood of victimization, in this particular case of young female victims, primarily in the context of IPV, sexual abuse, bullying, and/or exploitation. This implies that future research may focus on further elaborating on this framework, either extending, nuancing it, and/or validating its outcomes, for example, in non-Western and/or male samples. In addition, the findings of the Bayesian network may be helpful in explaining the process of revictimization. For instance, it was reported that the likelihood of sexual revictimization seems to increase with cumulative trauma and surviving multiple types of abuse (Classen et al., 2005). This is in line with current findings, which indicate that combinations of certain characteristics (e.g. childhood sexual abuse and childhood physical abuse) increase the likelihood of becoming victimized by aggressive and/or intimidating approaches, typically leading to victimization. Furthermore, some of the reported factors can be seen as both a risk factor for revictimization and a consequence of revictimization. Based on the current findings, it can therefore be hypothesized that characteristics can act as both a risk factor and consequence, increasing the likelihood of victimization (and therefore revictimization). However, longitudinal research is necessary to properly identify the process of consequences becoming risk factors for revictimization. Furthermore, the present model highlights the importance of individualized prevention, as well as protection and/or treatment of female victims. This fits with current developments in personalized psychotherapy, for example in the research fields of PTSD and BPD (Herzog & Kaiser, 2022; Kaiser & Herzog, 2023), of which the latter factor appeared to be of

relevance within the present model as well. It may therefore be of relevance to obtain more insights into the perpetrator characteristics and their potential relationships with the victim vulnerabilities identified here, to further unravel the victim–perpetrator interactions that are directly associated with established victimization, and how victimization comes into being through the effective use of aggressive and/or intimidating approaches by any given perpetrator.

5. Conclusions

Victimization can hypothetically be associated with an inherent susceptibility to aggressive and/or intimidating approaches. Indeed, because of the typical application of these aggressive and/or intimidating approaches within IPV, bullying, sexual abuse, or CSE, they may be considered as being instrumental in victimization and/or sustained coercion in this context.

Distinct variants of aggressive and/or intimidating approaches appear instrumental in this victimization process and, unfortunately, until now little research has been conducted on the complicated interactions of individual characteristics that make some people so susceptible to becoming victimized. This previous omission hinders the development of effective (targeted) prevention, treatment, and resilience-building strategies. In the present study, a first effort to design a victimization model has been described, in which the interdependencies of previously identified, although typically singularly presented, characteristics associated with victimization by aggressive and/or intimidating approaches are covered. Accordingly, it appeared feasible to estimate potential victimization by a variety of aggressive and/or intimidating approaches based on individual characteristics. Furthermore, the distinction between the physically violent, sexual, and non-physical intimidation features of these approaches proved sufficiently accurate to capture the previously published data collected from the victim perspective in this context. The current study may therefore be relevant in taking the first step towards more individualized treatment for the prevention of susceptibility to potential victimization by aggression/intimidation; based on these traits, it may be possible to understand which traits or susceptibility to specific aggressive and/or intimidating approaches would best respond to intervention. Therefore, the present findings may be of relevance for professionals in the field of IPV, sexual exploitation, and sexual abuse, as they may provide useful insights into those factors that could be addressed in prevention, and in the protection and/or treatment of (female) victims.

Future studies are needed to further unravel the victim–perpetrator interactions that are directly associated with established victimization following effectively used aggressive and/or intimidating approaches, and to determine whether the interdependencies described in the current study are related to less excessive instances of victimization by aggressive and/or intimidating approaches, and/or under regular circumstances (e.g. during the performance of professional tasks). The present findings may provide a useful basis for further research.

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Data availability statement

The data that support the findings of this study are openly available in Open Science Framework at https://osf.io/pb6m4/?view_only=4ded588a67b0443fbc9545ce83592dd6.

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Appendices

Appendix A

Table A1 shows the types of statistics considered useful or impractical for a Bayesian network to produce conditional probabilities for two factors of interest. Usually, the usable statistics must be transformed into conditional probabilities via calculation, simulation, or inference.

Table A1. Usable and unusable statistics for a Bayesian network.

Usable statistics	Unusable statistics
Correlations	Analysis of variance (ANOVA)
Direct regressions (logistic, binomial, logistic, zero order, bivariate)	Multivariate analysis of variance (MANOVA)
Interquartile ranges	Generalized linear model (GLM)
Proportions	Mann–Whitney *U*
Prevalences, probabilities	Hierarchical logistic regression
Group sizes, sample sizes	Multiple regression
Chi-squared statistics	*t*-Tests
D effect sizes	
Odds ratios (ORs)	
Adjusted odds ratios (AORs)	
Risk ratios (RRs)	
Relative risk ratios (RRRs)	

Appendix B

Table B1 lists all considered risk factors, their definitions, and search terms. For most of the factors, this table provides examples of assessment tools that we considered representative of our definitions. Terms mentioned but not included in the model were considered during the literature search, but removed for reasons described in the column 'Added to model'.

Appendix C

This appendix provides further explanation of the calculations of the contribution of each specific factor to the likelihood of victimization by four specific features of aggressive and/or intimidating approaches, displayed in Figure 4.

The contribution of each specific factor to the likelihood of victimization by aggressive and/or intimidating approaches was calculated by subtracting the estimated probability for the outcome when the input state of the factor of interest was 'absent', from the same outcome value when the input state of factor of interest was 'present', while assuming that no evidence is available for the other factors. For example, the contribution of depression on victimization by verbal aggressiveness is calculated by subtracting the probability of victimization by verbal aggressiveness when depression is absent from the probability of victimization by this type of aggressive and/or intimidation approach when depression is apparent. This was performed for the (predetermined) aggressive and/or intimidating approaches and provides an overview of the proportional contribution of each factor to the likelihood of victimization by aggressive and/or intimidating approaches in general ('likelihood of victimization', e.g. in the context of IPV), and the contribution of each factor to the likelihood of victimization by the four specific features of aggressive and/or intimidating approaches (physically violent, sexual, verbally aggressive, and non-verbal). Note that this provides only information about the contribution of a single factor. Multiple factors may reinforce, weaken, or overlap with each other.

Appendix D

The papers used to develop the Bayesian network are listed in Tables D1–D3. The three tables display the applied statistics for the factors of interest and the aggressive/intimidating approaches, intercharacteristic relationships, and the priors.

Table B1. Risk factors considered for inclusion in the model.

Term	Definition	Added to model	Assessments	Search terms
ADHD (attention deficit hyperactivity disorder)	ADHD symptoms include high levels of inattention, overactivity, and impulsiveness (Sonuga-Barke & Taylor, 2015)	Yes	DSM, ADHD symptom scale	ADHD, attention deficit hyperactivity disorder
Anger	We define anger as 'anger-out': the expression of an individual's anger towards other people or his/her surroundings (Funkenstein et al., 1954). Anger expression includes verbal or behavioural expressions.	No, due to statistics	BPAQ, STAXI	Anger, anger-out
Anxiety	Trait anxiety and anxiety disorder. A tendency to react or feel anxious (including anxiety disorder): according to DSM-V: excessive/disproportional anxiety and associated behavioural disorders. Including specific phobias (e.g. social anxiety disorder, panic disorder)	Yes		Anxiety, trait anxiety, anxiety disorder, social anxiety disorder, generalized anxiety
ASPD (antisocial personality disorder)	According to DSM-V: a personality disorder characterized by violating and neglect of the rights of others. Showing lack of empathy, disregard for social norms/rules, low tolerance to frustration, aggression and violence, no feelings of guilt, the urge to blame others for their behaviour, and persistent irritability (Ogloff, 2006)	No, no links with other nodes		ASPD, anti-social personality disorder, anti-social behaviour
Bipolar disorder	Manic–depressive illness. Bipolar disorder type I is characterized by recurrent episodes of depression and mania (Angst et al., 2003). Individuals diagnosed with bipolar disorder according to DSM-IV	No, not usable literature	DSM	Bipolar disorder
BPD (borderline personality disorder)	Individuals with a BPD diagnosis and individuals with BPD symptoms such as affect instability, identity problems, and interpersonal problems	Yes	DSM, Personality Assessment Inventory Borderline Features Scale (PAI-BOR)	Borderline, BPD, borderline personality disorder, borderline symptoms
Childhood physical abuse	Being a victim of physical abuse (by a family member)	Yes	CAMI	CPA, childhood physical abuse, childhood abuse, physical abuse
Childhood sexual abuse	Being a victim of sexual abuse (by a family member)	Yes	CAMI	CSA, childhood sexual abuse, childhood abuse, sexual abuse
Conduct disorder	Characterized by a pattern of aggressive, deceptive, and destructive behaviour that usually begins in childhood or adolescence (Nock et al., 2006)	No, no links with other nodes	DSM, CBCL	Conduct disorder, CD
Delinquency	Illegal and criminal behaviour, i.e. being part of a gang fight, using a weapon, theft, causing serious injury	No, due to statistics		Delinquency, delinquent, delinquent behaviour, criminal behaviour, criminality
Depression	The individual is showing symptoms of depression or is diagnosed with major depressive episode or major depressive disorder	Yes	BDI (Beck Depression Inventory), CIDI, CES-DC (Depression Scale for Children)	Depression, depressive symptoms
Early puberty	Age of menarche	Yes		Early puberty, age of menarche, early maturation
Early sexual behaviour	First sexual intercourse at age 15 or younger (De Graaf et al., 2017)	Yes		Early sexual behaviour, age at first intercourse
Educational level	The latest level of education the individual is following or has followed in their school career	No, due to other reasons. Complex to implement (confounding factor of age, type of statistics, etc.)		Level of education, degree attainment, educational degree
Emotion dysregulation	Control of emotional experience and expression (especially of negative emotional states) (Messman-Moore et al., 2010)	No, no connections with other nodes	DERS, Emotion Regulation Scale	Emotion dysregulation, emotion regulation deficits, emotional control, difficulties in emotion regulation, emotional functioning
Extraversion	Extraverts are outgoing, interactive, and sociable, have an external orientation, and like to be around people (Janowsky, 2001)	No, due to statistics/missing prior	Eysenck Personality Inventory, NEO-PI	Extraversion, outgoing, extravert
Friendship quality	High friendship quality is represented by closeness, companionship,	No, no usable literature		

(*Continued*)

Table B1. Continued.

Term	Definition	Added to model	Assessments	Search terms
	loyalty, prosocial behaviour, and other positive features			Friendship quality, low friendship quality, friendship closeness
Impulsivity	The (fast) reaction of acting without enough thinking and conscious judgement. These individuals act with less thinking in comparison with other people with the same levels of abilities and acquaintance (Arce & Santisteban, 2006). The individual is not thinking about the consequences of their actions or is not aware of the risk at all	Yes	(Non-planning subscale) BIS, NEO Personality Inventory, Eysenck Impulsivity Scale	Impulsivity, impulsive behaviour, impulsiveness
Introversion	Introverts prefer doing things alone and having restricted relationships, have an internal orientation, and are more reflective and reserved (MBTI, Jungian principles)	No, due to statistics/missing prior	Eysenck Personality Inventory, NEO-PI	Introversion, introvert
IQ	Intelligence quotient	No, due to other reasons. Not implementable		(Low) IQ, intelligence
Loneliness	Perceiving and experiencing the feeling of being alone	No, no links with other nodes		Loneliness, social isolation
Neuroticism	A wide personality trait; the extent to which an individual senses his/her surroundings as stressful, problematic, and threatening. Individuals with higher neuroticism experience negative emotions more frequently (Watson, 2001). They then show anxiousness, depression, emotional lability, guilt, anger, shame, and separation insecurity (Trull, 2012; Watson, 2001)	Yes	Eysenck Personality Inventory	Neuroticism, neurotic
NPD (narcissistic personality disorder)	A mental disorder in which the individual shows haughtiness, feels the need for deep admiration and inordinate attention, shows a lack of empathy, and has troubled relationships. The individual can also show signs of a superiority complex (which disguises frail self-esteem and feelings of failure)	Yes	DSM	Narcissistic personality disorder, NPD, narcissism
PTSD (post-traumatic stress disorder)	A disorder that is triggered by a traumatic experience. Symptoms include intrusive recollections of a traumatic event, emotional numbing and avoidance of reminders of that event, and physiological hyperarousal (Yule & Smith, 2015)	No	SCL-90R (Symptom Checklist), DSM	PTSD, post-traumatic stress disorder, PTSD symptoms
Risk-taking peers	The individual has contact with or is friends with peers who perform risk-taking behaviour (see term Risky behaviour)	No, due to statistics		Risk-taking peers
Risky behaviour	Intentional behaviour of an individual being aware of the risk of his/her behaviour. The individual creates and/or seeks dangerous situations. These include carrying a weapon, having a drug-using partner, graffitiing in illegal places, threatening people, not using condoms, and having multiple bed partners	Yes	ASR (Adult Self-Report)	Risky behaviour, risk-taking behaviour, risk seeking
School engagement	Level of commitment to school, including school conduct (good behaviour in class or problems reported by teachers), level of school attendance (truancy), whether the individual has ever been expelled from school, and school motivation (e.g. motivated or dropped out of school)	No, due to statistics/missing prior		School engagement, school motivation, truancy, school conduct, dropout, school difficulties
School performance	How well the individual is/was performing at school, i.e. academic achievement, such as grade point average (GPA), and whether the	No, due to statistics		School performance, GPA, school difficulties

(*Continued*)

Table B1. Continued.

Term	Definition	Added to model	Assessments	Search terms
	individual had to repeat a class or classes			
Self-control	The ability to inhibit and adapt impulses, emotions, thoughts, and conduct in accordance with standards and personal aims (Baumeister et al., 2007; Inzlicht et al., 2014)	No, no usable literature	Motor Subscale BIS	Self-control, impulse control, cognitive control
Self-esteem	An individual's overall sense of self-worth. It describes the degree of the individual's self-appreciation, approval, and liking (Adler & Stewart, 2004). We also included self-image under this definition	No, no links with other nodes	Rosenberg Self-esteem Scale	Self-esteem, low self-esteem, self-image
Sensation seeking	Novelty seeking, interested in extreme activities	No, overlap with other nodes (impulsivity, risky behaviour)	Sensation Seeking Scale	Sensation seeking, novelty seeking
Social skills	The way an individual communicates with others verbally and non-verbally, including the ability to make contact and become friends with other people. Social skills stand for collaborative competency, the belief and ability to work together with partners to complete a task (Gresham & Elliott, 1990; Segrin & Kinney, 1995). Social efficacy is also covered by the term social skills. Shyness is seen as a lack of social skills. Social anxiety is also included	No, no links with other nodes	Social Skills Scale, Social Skills Rating System	Social skills, shyness, lack of social skills, social anxiety, social efficacy, social ability
Substance abuse	Regular use of substances such as alcohol and/or drugs, such that it causes problems. Tea and coffee are not included. Addiction/disorder is not included	Yes	AUDIT	Substance use, substance abuse, drug (ab)use, alcohol (ab)use
Traumatic experiences	Adverse life events such as experiencing death and/or sickness of a family member or experiencing abuse by someone other than a family member	No, overlap with other nodes (PTSD, CSA, CPA, witnessing family violence, etc.)		Traumatic experiences, adverse life events, adverse childhood experiences, ACE, childhood trauma
Unstructured home situation	An abnormal situation in which the individual is missing organization, e.g. the individual is/has been a victim of emotional abuse and/or neglect, had too many siblings to be controlled on their behaviour regularly, is/was in a single-parent family, or has a difficult relationship with his/her caretaker(s)	No, due to statistics/missing prior		Home situation, adverse home situation, unstructured home situation, adverse childhood experiences
Witnessing family violence	Unsafe home situation. Witnessing physical and/or sexual abuse of a family member (by another family member)	Yes	CTS (Conflict Tactics Scale)	Witnessing family violence, domestic violence, family violence, violence at home, interparental violence
Physical intimidation	Is physically harmed and/or threatened with physical aggression (e.g. kicking, slapping, or pushing)	Yes	OBVQ-R, CTS-2 (Conflict Tactics Scale)	Physical intimidation, physical aggression, intimate partner violence, IPV, physical abuse
Sexual intimidation	Is a victim of rape and/or unwanted physical sexual contact (e.g. touching, forced intercourse, forced sexual acts)	Yes	SES (Sexual Experience Survey), CTS-2	Sexual intimidation, sexual harassment, sexual victimization, sexual coercion
Verbal intimidation	Being yelled at, cursed at, verbally insulted, called names	Yes	CTS-2	Relational aggression, verbal aggression, verbal intimidation, psychological abuse/intimidation/aggression
Non-verbal intimidation	Is isolated and/or set up against friends/family, or friends/family were set up against the victim	Yes	CTS-2	Non-verbal intimidation, relational aggression, psychological abuse/ intimidation/aggression
Online intimidation		No, too complex. Needs its own model		

Table D1. Applied statistics for the 'victimization by aggressive and/or intimidating approaches' model, including references.

	Reported statistic(s)			Outcome			
Reference	Type	Value	Reported characteristic(s)	Physical	Verbal	Non-verbal	Sexual
Mcvean (2017)	Prevalences of bullying victimization, correlation	36 out of 379 (9.5%) $r = 0.32$, $p < .01$	Depression	✓			
Mcvean (2017)	Prevalences of bullying victimization, correlation	118 out of 379 (31.1%) $r = 0.49$, $p < .01$	Depression		✓		
Mcvean (2017)	Prevalences of bullying victimization, correlation	93 out of 379 (24.7%) $r = 0.46$, $p < .01$	Depression			✓	
White & Buehler (2012)	Prevalence of sexual victimization, correlation	Adolescent sexual victimization = 38% $r = 0.20$, $p < .05$	ADHD				✓
Messman-Moore et al. (2010)	Prevalences, chi-squared	6.3% of women ($n = 47$) reported a history of CSA and 25.5% ($n = 192$) reported a history of CPA. 17.8% ($n = 134$) of women reported at least one experience of adolescent or adult rape since age 14 CSA–adolescent/adult rape $\chi^2(1, n = 744) = 4.71$, $p = .03$; with 29.8% of CSA victims reporting adult rape compared to 17.2% of CSA non-victims CPA–adolescent/adult rape $\chi^2(1, n = 744) = 6.87$, $p = .009$; with 24.3% of CPA victims reporting adult rape compared to 15.9% of CPA non-victims	CPA, CSA				✓
Vicary et al. (1995)	Prevalences, chi-square	Early menarche: abused sample 88%, non-abused 69%, $\chi^2 = 4.371$, $p < .05$ Early sexual behaviour: abused sample 50%, non-abused sample, 27% $\chi^2 = 4.95$, $p < .05$ Prevalence of unwanted sexual abuse by dates/boyfriends = 26 (23%)	Early puberty, early sexual behaviour				✓

Note: The table shows interdependencies between the factors of interest for the likelihood of becoming victimized by one of the four features of aggressive and/or intimidating approaches. Each row displays which type of statistics are mentioned within the stated article and the relevant values for the creation of the Bayesian network. The reported statistic is associated with or related to the outcome characteristic.

ADHD = attention deficit hyperactivity disorder; CSA = childhood sexual abuse; CPA = childhood physical abuse; Physical = physically violent approaches; Verbal = verbally aggressive approaches.

Table D2. Applied statistics of intercharacteristic relationships for the 'victimization by aggressive and/or intimidating approaches' model.

Reference	Reported statistics		Reported characteristic	Outcome characteristic
	Type	Value		
Bernardi et al. (2012)	Odds ratios	OR = 9.32, $p < .05$	ADHD	BPD
Bernardi et al. (2012)	Odds ratios	OR = 4.82, $p < .05$	ADHD	Impulsivity
Bernardi et al. (2012)	Odds ratios	OR = 5.57, $p < .05$	ADHD	NPD
White & Buehler (2012)	Prevalences, correlation	Prevalence of risky sexual behaviour = 64.7%; $r = 0.19$, $p < .05$	ADHD	Risky behaviour
Scott et al. (2014)	Prevalence, regression	Prevalence of borderline symptoms = 43% ($n = 64$); $B = 0.39$, $p < .01$	BPD	Impulsivity
Messman-Moore et al. (2010)	Prevalences, chi-square	6.3% of women ($n = 47$) reported a history of CSA and 25.5% ($n = 192$) reported a history of CPA. 17.8% ($n = 134$) of women reported at least one experience of adolescent or adult rape since age 14. Total sample was $n = 752$ CSA-CPA $\chi^2(1, n) = 752) = 20.17$, $p < .001$; 53.2% of CSA victims also experienced CPA and 13% of CPA victims also experienced CSA	CSA	CPA
Khurana et al. (2012)	Prevalences, regression	16% ($n = 55$) of the 347 adolescents had intercourse by the follow-up, of whom 25 reported being sexually experienced at baseline (7%) $B = 0.47$, $p < .05$	Impulsivity	Early sexual behaviour
Stinson et al. (2008)	Prevalences	P(NPD|Substance abuse) = 7%; 34,653 adults participating in the Wave 2 NESARC	NPD	Substance Abuse
Stinson et al. (2008)	Prevalences	P(NPD|Depression) = 5.8%; 34,653 adults participating in the Wave 2 NESARC	NPD	Depression
Stinson et al. (2008)	Prevalences	P(NPD|Anxiety) = 12.8%; 34,653 adults participating in the Wave 2 NESARC	NPD	Anxiety
Goodwin et al. (2003)	Prevalences	Childhood sexual abuse in (1) low neuroticism = 5.8%, (2) 7.4%, (3) 13.4%, (4) 19.6%, $p < .0001$	CSA	Neuroticism
Goodwin et al. (2003)	Prevalences	Anxiety disorder in (1) low neuroticism = 0.8%, (2) = 0.5%, (3) = 3.1%, (4) high neuroticism = 8.3%, $p < 0.05$; low neuroticism = 1.1% had social phobia, (2) = 5.5%, (3) = 6.6%, 4 (high neuroticism) = 13.8% had social phobia, $p < .0001$	Neuroticism	Anxiety
Goodwin et al. (2003)	Prevalences	Depression in low neuroticism = 15.2%, (2) = 20.9%, (3) = 25.2%, (4) high neuroticism = 34.9%, $p < .0001$	Neuroticism	Depression
Goodwin et al. (2003)	Prevalences	Low neuroticism = 18.3%, (2) 19.9%, (3) 22.6%, (4) high = 29.2%, $p < .01$	Witnessing family violence	Neuroticism
Vanheusden et al. (2008)	Prevalences, odds ratios	Non-drinkers = 410; occasional = 490; low level = 822; higher level = 313; excessive = 203 Rule-breaking behaviour – excessive drinkers: OR = 3.72, $p < .01$	Risky behaviour	Substance abuse

Note: Each row displays which type of statistics are mentioned in the stated article and which were relevant values for the creation of the Bayesian network. The reported statistic is associated with or related to the outcome characteristic.

ADHD = attention deficit hyperactivity disorder; BPD = borderline personality disorder symptoms; CSA = childhood sexual abuse; CPA = childhood physical abuse; NPD = narcissistic personality disorder symptoms; Physical = physically violent approaches; Verbal = verbally aggressive approaches.

Table D3. Applied statistics for priors within the 'Victimization by aggressive and/or intimidating approaches' model.

Reference	Reported statistics		Reported characteristic
	Type	Value	
Dattani et al. (2018)	Prevalences	284 million individuals (3.8%)	Anxiety
Tuithof et al. (2014)[a]	Prevalences	Population of Netherlands, children = 2.9%; adults = 2.1%; *N* = 3309	ADHD
Grant et al. (2008)	Prevalences	Lifetime BPD = 5.9%, 34,653 adults participating in the Wave 2 NESARC	BPD
Messman-Moore et al. (2010)	Sample sizes and percentages	47 out of 752 (6.3%)	CSA
Goodwin et al. (2003)	Prevalences	16–18 years = 20.8%; 18–21 years = 23.6%	Depression
Goodwin et al. (2003)	Sample sizes	1 (low) = 275; 2 = 229; 3 = 232; 4 (high) = 225 Total sample = 961	Neuroticism
Vicary et al. (1995)	Sample sizes and percentages	88% of the abused adolescent girls; 69% of the non-abused girls; total sample = 112; abused sample = 26	Early puberty
Vicary et al. (1995)	Sample sizes and percentages	50% of the abused adolescent girls; 27% of the non-abused girls; total sample = 112; abused sample = 26	Early sexual behaviour
Chamorro et al. (2012)	Prevalences	16.9%	Impulsivity
Stinson et al. (2008)	Prevalences	4.8%	NPD
Marret & Choo (2017)	prevalences	47.5%	Risky behaviour
Young et al. (2002)	prevalences	Any substance abuse in adolescents (12–18 years) = 13.9%	Substance abuse
Iverson et al. (2014)	Sample sizes and percentages	126 out of 670 (18.9%)	Witnessing family violence
Mcvean (2017)	Prevalences	36 out of 379 (9.5%)	Physical
Mcvean (2017)	Prevalences	118 out of 379 (31.1%)	Verbal
Mcvean (2017)	Prevalences	93 out of 379 (24.7%)	Non-verbal
Daspe et al. (2016)	Prevalence rates	Lifetime prevalence of experienced sexual coercion = 16.7%	Sexual

Note: In case additional prior knowledge was needed for the calculation of conditional probabilities, priors were extracted from articles and population studies. Each row displays which type of statistics and relevant values were used as prior knowledge for the calculation of conditional probabilities within the Bayesian network.

[a]Dutch article.

ADHD = attention deficit hyperactivity disorder; BPD = borderline personality disorder symptoms; CSA = childhood sexual abuse; NPD = narcissistic personality disorder symptoms; Physical = physically violent approaches; Verbal = verbally aggressive approaches.