Neuropsychological functioning during childhood and its association with intimate partner violence against women (IPVAW) in early adulthood

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Abstract

Purpose – *Intimate partner violence against women (IPVAW) is a global issue associated with significant adverse consequences for women who experience it. Despite extensive research on social and behavioural factors, the role of neuropsychological variables in IPVAW perpetration remains underexplored. The purpose of this study is to examine whether neuropsychological performance indicators during childhood and early adolescence (ages 8, 10 and 11), specifically attention, working memory, verbal intelligence quotient (IQ), performance IQ and total IQ, are associated with IPVAW perpetration in early adulthood.*

Design/methodology/approach – *This study used longitudinal cohort data (Avon Longitudinal Study of Parents and Children study), examining neuropsychological assessments during childhood (ages 8, 10 and 11) and IPVAW perpetration in early adulthood. Statistical analyses, including logistic regression, were used to analyse neuropsychological performance and its association with IPVAW perpetration in early adulthood.*

Findings – *Overall, male IPVAW perpetrators and non-perpetrators displayed similar neuropsychological performance. In addition, none of the cognitive functions assessed at ages 8, 10 and 11 were associated with subsequent IPVAW perpetration in early adulthood.*

Research limitations/implications – *This study underscores the need for research on longitudinal risk factors for IPVAW perpetration focusing on the development of effective prevention strategies and intervening at early ages.*

Originality/value – *To the best of the authors' knowledge, this is the first study to analyse the neuropsychological performance in childhood of male IPVAW perpetrators at 21.5 years and non-perpetrators using longitudinal data.*

Keywords *Intimate partner violence, Perpetrators, Neuropsychological functioning, ALSPAC, Longitudinal*

Paper type *Research paper*

Introduction

Intimate partner violence against women (IPVAW) is defined as any act of physical, psychological, sexual abuse or any other controlling behaviour perpetrated by a current or former partner [World Health Organization (WHO), 2013]. IPVAW affects approximately one in three females worldwide (WHO, 2021a, 2021b) and it is associated with adverse physical, psychological and social consequences (García-Moreno *et al.*, 2013; Smith *et al.*, 2017).

Studying the underlying factors of male IPVAW perpetration is crucial for developing better strategies to reduce and prevent it (WHO, 2021a, 2021b). Although there is a clear focus on

the impact of neuropsychological variables, especially executive functioning on male IPVAW perpetrators, the body of neuropsychological research related to IPVAW is relatively scarce compared to studies on social and behavioural factors (Godfrey *et al.*, 2022). In addition, most studies have predominantly focused on adult males already convicted of IPVAW offences (see Horne *et al.*, 2020; Humenik *et al.*, 2020). These studies have not explored neuropsychological performance during earlier developmental stages, such as childhood, or its potential implications for IPVAW perpetration in adulthood. This underscores the need for prospective studies to fill this critical gap in knowledge.

The examination of executive functioning involves three domains:

1. inhibition, which entails the intentional suppression of a dominant or prepotent response;
2. shifting, defined as the capacity to execute a new operation despite proactive interference; and
3. updating, characterised by the active maintenance of information in mind, involving the replacement of outdated and no longer pertinent information with newer and more relevant data (Miyake *et al.*, 2000).

A substantial body of literature provides evidence for an association between executive functioning and aggression (e.g. Bannon *et al.*, 2015; Hecht and Latzman, 2018; Micai *et al.*, 2015). In this sense, the Social Information Processing model (Crick and Dodge, 1994) provides a theoretical framework for understanding how deficits in executive functioning might contribute to IPVAW perpetration. According to this model, cognitive impairments, such as difficulties in attention, working memory or verbal and performance intelligence quotient (IQ), can influence an individual's ability to interpret social cues accurately, assess relational dynamics and generate appropriate behavioural responses. These deficits may increase the likelihood of misinterpreting cues as hostile or failing to regulate impulsive reactions, thereby potentially escalating conflicts into aggression (Cole *et al.*, 2022; Diamond, 2013).

In this sense, previous research has found that executive functioning is a risk factor for committing violent crimes (Cruz *et al.*, 2019). A meta-analysis examining individuals from early childhood to adulthood found a strong negative relationship between executive function and antisocial behaviour (Ogilvie *et al.*, 2011). Nevertheless, IPVAW and general aggression represent two separate constructs (see Humenik *et al.*, 2020) that differ in terms of personality traits, antisocial behaviour and the presence of psychopathology (Boyle *et al.*, 2008; Collison and Lynam, 2023; Moffitt *et al.*, 2000). In addition, IPVAW is deeply connected to relationship dynamics and gender norms, particularly in how power and control are exercised, which is less common in other forms of violence or antisocial behaviours (see Thornton *et al.*, 2016). Furthermore, differences in neuropsychological performance have been identified between IPVAW perpetrators and other convicted offenders (see Becerra-García, 2015; Bueso-Izquierdo *et al.*, 2016; Fox *et al.*, 2022; Hanlon *et al.*, 2016), further highlighting the distinct nature of IPVAW. Therefore, findings related to other forms of violence or antisocial behaviours may not directly translate to IPVAW perpetration. Consequently, an analysis of the relationship between executive functioning and male IPVAW perpetration is suggested (Romero-Martínez *et al.*, 2023) to determine whether executive functioning also constitutes a risk factor in the perpetration of IPVAW, as it does in general aggression.

Research on executive functioning in male IPVAW perpetrators has shown consistent differences compared to non-perpetrators. For example, these individuals tend to exhibit lower cognitive flexibility, which refers to the ability to adapt to changing circumstances or shift attention between tasks (Horne *et al.*, 2020; Humenik *et al.*, 2020). Similarly, they often perform worse in tasks requiring verbal fluency (the ability to generate words quickly and

efficiently), planning and decision-making (Romero-Martínez *et al.*, 2019a, 2019b, 2021a, 2021b; Vitoria-Estruch *et al.*, 2018). Differences in working memory, defined as the capacity to hold and manipulate information temporarily, have been documented, with perpetrators scoring lower than non-perpetrators (Romero-Martínez *et al.*, 2023; Vitoria-Estruch *et al.*, 2018). Regarding inhibition – the ability to suppress inappropriate or automatic responses – the findings are mixed. Some studies report no significant differences between perpetrators and non-perpetrators (Easton *et al.*, 2008), whereas others suggest that perpetrators may perform better in specific inhibition tasks (Cohen *et al.*, 2003; Lishak *et al.*, 2021). These latter findings indicate that some male IPVAW perpetrators possess adequate inhibitory control, allowing them to regulate their responses and avoid acting impulsively under certain conditions. Finally, perpetrators show greater difficulties with attention switching, requiring more effort to shift focus from one task or stimulus to another (Romero-Martínez *et al.*, 2019b).

Previous research underscores the critical role of neuropsychological assessments in understanding IPVAW perpetration (Romero-Martínez *et al.*, 2023). However, systematic reviews on IPVAW perpetration have largely neglected the neuropsychological characteristics of individuals before their engagement in such behaviours (e.g. Clare *et al.*, 2021; Costa *et al.*, 2015). This gap highlights the importance of early identification and monitoring of cognitive deficits, which could enhance the effectiveness of treatments (Casaletto and Heaton, 2017) and inform the development of targeted preventive interventions. Addressing this gap requires longitudinal studies, which are crucial for identifying the risk and protective factors associated with male IPVAW perpetration and clarifying the temporal sequence of such behaviours (Costa *et al.*, 2015). Notably, no longitudinal studies to date have specifically examined the relationship between cognitive functions and subsequent IPVAW perpetration. This makes it necessary to explore whether the neuropsychological performance during childhood and early adolescence can be associated with IPVAW perpetration in early adulthood. Such knowledge would not only clarify the mechanisms underlying IPVAW but also contribute to the design of more effective preventive interventions aimed at at-risk populations (Casaletto and Heaton, 2017).

In this context, it is crucial to study how neuropsychological variables in childhood and early adolescence interact and influence future behaviour. Cognitive functions such as attention, working memory and IQ have been identified as variables associated with the IPVAW perpetration (see Romero-Martínez *et al.*, 2023). In this regard, although attention and working memory have traditionally been considered as distinct constructs, evidence suggests significant overlap between them. Attention plays a pivotal role in the maintenance and manipulation of working memory, underscoring their interdependence (Kane *et al.*, 2001; Chen *et al.*, 2017). Similarly, intellectual functioning demonstrates a well-established negative association with aggressive and antisocial behaviours, including IPVAW perpetration, with lower IQ scores correlating with a higher propensity for such behaviours (Nixon *et al.*, 2017; Romero-Martínez *et al.*, 2023). Moreover, previous studies have found that these neuropsychological variables are interrelated in childhood (Ger and Roebers, 2023). Taking the above into consideration, we propose the following research question:

RQ1. Is neuropsychological performance during childhood and early adolescence associated with IPVAW perpetration in early adulthood?

Specifically, we examined each participant's performance in attention, working memory, verbal IQ and performance IQ at ages 8, 10 and 11. This age range was selected because adolescence, though variable across cultures, typically begins between ages 10 and 12 (Kapur, 2015).

The objective of this study is to examine whether neuropsychological performance indicators during childhood and early adolescence (ages 8, 10 and 11) – specifically attention, working memory, verbal IQ and performance IQ – are associated with IPVAW perpetration in early adulthood.

Method

Participants and procedure

Data were taken from the Avon Longitudinal Study of Parents and Children study (ALSPAC). ALSPAC is a transgenerational prospective study that investigates influences on health and development across the life course. Pregnant women resident in [omitted information] with expected dates of delivery between 1 April 1991 and 31 December 1992 were invited to take part in the study. The initial number of pregnancies enrolled was 14,541. Of the initial pregnancies, 13,988 children were alive at one year of age. When the oldest children were approximately seven years of age, an attempt was made to bolster the initial sample with eligible cases who had failed to join the study originally. As a result, when considering variables collected from the age of seven onwards, there is data available for more than the 14,541 pregnancies mentioned above. The total sample size for analyses using any data collected after the age of seven is therefore 15,447 pregnancies. The enrolled sample consisted of 14,775 live-born children. Of them, ALSPAC collected data directly from 14,009 children, through self-reported data from children as well as data provided about the child by the biological mother/primary caregiver (Boyd *et al.*, 2013, 2013; Fraser *et al.*, 2013). Please note that the study website contains details of all the data that is available through a fully searchable data dictionary and variable search tool in the following webpage: www.bristol.ac.uk/alspac/researchers/our-data/

Ethical approval for the study was obtained from the ALSPAC ethics and law committee and the local research ethics committees. Informed consent for the use of data collected via questionnaires and clinics was obtained from participants following the recommendations of the ALSPAC ethics and law committee at the time. Written informed consent was also obtained from the parents of participating children after providing a comprehensive explanation of the study. In addition, children were invited to provide their assent where appropriate. Participants retain the right to withdraw their consent for specific elements of the study or to withdraw from the study entirely at any time. Full details of the study's consent procedures are available on the ALSPAC website: www.bristol.ac.uk/alspac/researchers/research-ethics/

For the present study, we selected mostly heterosexual men from the total sample who, at 21.5 years of age, completed a questionnaire assessing whether they had engaged in physical, psychological and/or sexual violence against their partners ($n = 1{,}011$). There is a reduction of participants from the total sample of ALSPAC study because only male and heterosexual participants who reported that had a partner at the moment of the assessment or previously were selected. These men were subsequently divided into two groups: those who reported having committed some form of IPVAW perpetration ($n = 150$), referred to as "IPVAW perpetrators," and those who reported no violent behaviour towards their partners ($n = 848$), referred to as "non-IPVAW perpetrators." To balance the number of participants in each group, a random selection of 185 individuals from the 848 non-IPVAW perpetrators was drawn from the database. Both groups were matched in terms of age, sex, educational level and sexual orientation.

In addition, we excluded for the purpose of this study women ($n = 7{,}348$), those men who had a sexual orientation different from heterosexual ($n = 104$) and those who did not complete the questionnaire about IPVAW perpetration. Moreover, those participants who had not completed any neuropsychological assessment tasks were also excluded ($n = 13$).

Measures

Sociodemographic information. Data on occupational social class were obtained as classified by the OPCS in 1991 (classes I "professional", II "managerial and technical", III "skilled non-manual", IV "skilled manual", V "partly skilled" and VI "unskilled manual

workers") (OPCS, 1991), collected through an interview with the mother when the children were four years old.

Intimate partner violence (IPVAW) perpetration. At age 21.5, participants completed an online questionnaire (Yakubovich *et al.*, 2019). The IPVAW section of the questionnaire was based on the previous National Society for the Prevention of Cruelty to Children questionnaire and the PROVIDE survey. Four items measured physical, psychological and sexual IPVAW perpetration. Participants indicated the frequency of each item in a four-point Likert scale (1: never; 2: once; 3: a few times; 4: often). We grouped male participants to have perpetrated IPVAW if they had responded at least "once" for any of the questions (coded as "1"). Those who had responded "never" were grouped as non-IPVAW perpetrators (coded as "0").

Neuropsychological performance. IQ scores. At age 8, the WISC-III (Wechsler *et al.*, 1992) was used as an instrument for evaluating cognitive function. The ten WISC subtests include five verbal (Information, Similarities, Arithmetic, Vocabulary and Comprehension) and five performance (Picture Completion, Coding, Picture Arrangement, Block Design and Object Assembly) assessments. Final WISC IQ scores (verbal and performance IQ) were calculated from the total scaled scores using the provided look-up tables in the WISC manual (for detailed information on subtest administration and scoring, please see WISC manual).

Attention. At ages 8 and 11, participants underwent assessment using the Test of Everyday Attention for Children (TEA-Ch) protocol (Manly *et al.*, 1998). Three specific tasks were selected from this battery: the Sky Search task, the Sky Search dual task and the Opposite-Worlds task. The Sky Search task assessed selective attention. The task requires participants to identify pairs of identical "spacecraft" among visually similar stimuli. Performance metrics, including time and accuracy, were recorded, and a motor control condition was included. Selective attention was computed by subtracting the time taken for the Sky Search task from the time taken for the motor task, divided by the respective number of correctly circled spaceship pairs. Secondly, the Sky Search dual task involved the same selective attention task with the additional requirement for the child to count spaceship noises played concurrently. The dual task decrement score was derived by subtracting the score of the selective attention task from the score obtained in the dual task, accounting for the amplified decrement in performance observed with the addition of the extra task. Finally, the Opposite-Worlds subtask, derived from the TEA-Ch assessment, resembles a simplified Stroop task where a sequence of numbers was presented to children, and they must respond verbally in contradiction to the provided visual information. The score is computed as the meantime taken for the opposite-worlds condition subtracted from the meantime taken for the same-worlds condition, indicating the extent of performance impairment observed in the opposite-worlds condition.

Working memory. At age 10, to assess working memory, the Counting Span Task was used, as outlined by Case *et al.* (1982). This task involves simultaneous processing and retention of information. Participants viewed arrays of red and blue dots on a computer display, and they were instructed to verbally identify and count the red dots. The task included various stages with increasing difficulty. After each set, participants recalled the number of red dots on each screen in the sequence presented. The tester recorded responses after each set. Regardless of overall performance, all participants completed all sets. The Global score, reflecting the number of correctly completed trials, was computed.

Data analysis

The statistical software package SPSS 28 was used for the analyses. First, IPVAW perpetration was treated as a binary variable, with IPVAW perpetrators coded as 1 and non-IPVAW perpetrators coded as 0.

Following this, a Chi-square analysis was conducted to determine whether there were differences in social class based on the mother's occupation between the two groups, as this variable could potentially influence neuropsychological performance (see Stautz *et al.*, 2016). The results indicated no significant differences between the groups ($\chi^2 = 9.751$, $p =$ 0.083). Consequently, it was not included as a covariate in the subsequent analyses (see dmentary material).

In addition, Pearson correlations were conducted between neuropsychological measures to assess potential overlap among them.

Next, descriptive analyses of neuropsychological performance measures were carried out for both IPVAW perpetrators and non-IPVAW perpetrators.

Finally, a logistic regression analysis was performed using the enter method to investigate whether performance in attention, working memory, verbal IQ and performance IQ at ages 8, 10 and 11 were associated with subsequent IPVAW perpetration in early adulthood, specifically examining the likelihood of belonging to the IPVAW perpetrator group compared to the non-IPVAW perpetrator group. The continuous predictors were standardised so that the odds ratios (OR) presented correspond to a 1 standard deviation (1SD) increase. Signification level was $p = \leq 0.05$.

Results

Correlations between neuropsychological variables

The correlation table shows that there was a correlation between different neuropsychological variables. However, an overlap was identified between the scores obtained in the verbal and performance subtests of the WISC at age 8 and the total score. Therefore, the Total WISC score was excluded from the analyses (see Table 1).

Neuropsychological performance of the groups

Descriptive analyses were conducted to compare the neuropsychological performance between the IPVAW-P and IPVAW-NP groups across various measures taken between the ages of 8,10 and 11. Overall, the results showed that the average scores on cognitive tests were generally similar between the two groups (see Table 2).

Logistic regression analysis of neuropsychological factors associated with intimate partner violence against women perpetration

The results of the overall model were not statistically significant ($\chi^2 = 8.888$, $p = 0.543$), indicating that the included variables explained a limited proportion of the variance (adjusted R^2 of Nagelkerke $= 0.059$). In addition, none of the individual neuropsychological variables was significant ($p < 0.05$) in increasing the likelihood of IPVAW perpetration in early adulthood (see Table 3). This would mean that performance in attention, working memory and verbal and performance IQ measured during childhood and early adolescence for each participant would not be related to subsequent IPVAW perpetration during early adulthood.

Discussion

The objective of this study was to explore whether neuropsychological performance indicators during childhood and early adolescence (ages 8, 10 and 11) – specifically attention, working memory, verbal IQ and performance IQ – are associated with IPVAW perpetration in early adulthood. Results do not provide evidence of significant neuropsychological differences between IPVAW perpetrators and non-IPVAW perpetrators, as both groups scored similarly on neuropsychological performance at ages 8, 10 and 11.

Table 1 Correlations between neuropsychological variables

Variable	*WISC-Verbal IQ (8 years)*	*WISC-Performance IQ (8 years)*	*WISC-Total IQ (8 years)*	*Att sky search (8 years)*	*Att dual task (8 years)*	*Inhibition (8 years)*	*Working memory (10 years)*	*Inhibition (11 years)*	*Att sky search (11 years)*	*Att dual task (11 years)*
WISC-Verbal IQ (8 years)										
Pearson's correlations *(r)*	1	**0.368**	**0.858**	−0.184	−0.105	−0.087	**0.352**	−0.042	−0.115	**−0.145**
p		**<0.001**	**<0.001**	0.003	0.102	0.156	**<0.001**	0.507	0.062	**0.018**
WISC-Performance IQ (8 years)										
Pearson's correlations *(r)*	*0.368*	1	**0.790**	**−0.285**	−0.111	**−0.216**	**0.261**	−0.116	**−0.232**	**−0.153**
p	*<0.001*		**<0.001**	**<0.001**	0.083	**<0.001**	**<0.001**	0.064	**<0.001**	**0.013**
WISC-Total IQ (8 years)										
Pearson's correlations *(r)*	*0.858*	**0.790**	1	**−0.283**	**−0.128**	**−0.180**	**0.389**	−0.088	**−0.176**	**−0.208**
p	*<0.001*	**<0.001**		**<0.001**	**0.047**	**0.003**	**<0.001**	0.162	**0.004**	**<0.001**
Att Sky Search (8 years)										
Pearson's correlations *(r)*	*−0.184*	**−0.285**	**−0.283**	1	0.044	**0.153**	**−0.175**	0.058	0.042	**0.389**
p	*0.003*	**<0.001**	**<0.001**		0.493	**0.013**	**0.007**	0.365	0.508	**<0.001**
Att Dual Task (8 years)										
Pearson's correlations *(r)*	−0.105	−0.111	**−0.128**	0.044	1	**0.178**	−0.102	**0.165**	**0.147**	**0.230**
p	0.102	0.083	**0.047**	0.493		**0.005**	0.132	**0.013**	**0.025**	**<0.001**
Inhibition (8 years)										
Pearson's correlations *(r)*	−0.087	**−0.216**	**−0.180**	**0.153**	**0.178**	1	**−0.173**	**0.174**	**0.166**	0.031
p	0.156	**<0.001**	**0.003**	**0.013**	**0.005**		**0.007**	**0.006**	**0.008**	0.617
Working memory (10 years)										
Pearson's correlations *(r)*	**0.352**	**0.261**	**0.389**	**−0.175**	−0.102	**−0.173**	1	−0.052	**−0.230**	−0.116
p	**<0.001**	**<0.001**	**<0.001**	**0.007**	0.132	**0.007**		0.412	**0.001**	0.062
Inhibition (11 years)										
Pearson's correlations *(r)*	−0.042	−0.116	−0.088	−0.175	−0.102	0.174	−0.052	1	0.086	0.106
p	0.507	0.064	0.162	**0.007**	0.132	0.006	0.412		0.155	**0.079**
Att Sky Search (11 years)										
Pearson's correlations *(r)*	−0.115	**−0.232**	**−0.176**	**0.042**	**0.147**	**0.166**	**−0.230**	0.086	1	**0.036**
p	0.062	**<0.001**	**0.004**	0.508	**0.025**	**0.008**	**0.001**	0.155		0.540
Att Dual Task (11 years)										
Pearson's correlations *(r)*	**−0.145**	**−0.153**	**−0.208**	**0.389**	**0.230**	0.031	−0.116	0.106	0.036	1
p	**0.018**	**0.013**	**<0.001**	**<0.001**	**<0.001**	0.617	0.062	0.079	0.540	

Note(s): Pearson's correlation coefficients (*r*) are reported. Significant correlations ($p < 0.05$) are in *bold*
Source(s): Authors' own creation

Table 2 Neuropsychological performance of the groups

Variable	*IPVAW-NP (n = 185) average ± SD*	*IPVAW-P (n = 150) average ± SD*
WISC-Verbal IQ (8 years)	112.74 ± 18.1	115.65 ± 15.16
WISC-Performance IQ (8 years)	101.99 ± 17.61	104.33 ± 14.08
WISC-Total IQ (8 years)	108.81 ± 17.14	112.04 ± 12.74
Att sky search (8 years)	5.03 ± 1.33	5.25 ± 1.92
Att dual task (8 years)	5.6 ± 11.56	3.96 ± 8.37
Inhibition (8 years)	4.18 ± 2.7	3.88 ± 2.62
Working memory (10 years)	19.15 ± 7.86	19.33 ± 7.63
Inhibition (11 years)	2.49 ± 1.74	2.56 ± 1.7
Att sky search (11 years)	3.75 ± 1.14	3.63 ± 0.9
Att dual task (11 years)	1.35 ± 5.11	1.04 ± 2.05

Note(s): SD = standard deviation; omitted information. IPVAW-NP = IPVAW no perpetrators. IPVAW-P = IPVAW perpetrator **Source(s):** Authors' own creation

Table 3 Results of logistic regression analysis for differentiating between IPVAW perpetrators and non-perpetrators

Block	*Chi-square*	R-*square of Nagelkerke*		p-*model*
Block 1	1.567	0.010		0.997
Variable	*B*	*P*	*OR*	*95% CI*
WISC-Verbal IQ (8 years)	0.020	0.889	1.020	(0.750, 1.386)
WISC-Performance IQ (8 years)	−0.006	0.968	0.994	(0.744, 1.328)
Att sky search (8 years)	−0.046	0.430	0.955	(0.852, 1.072)
Att dual task (8 years)	−0.043	0.781	0.958	(0.708, 1.297)
Inhibition (8 years)	0.036	0.810	1.037	(0.773, 1.391)
Working memory (10 years)	0.003	0.862	1.003	(0.965, 1.043)
Inhibition (11 years)	0.049	0.740	1.050	(0.787, 1.402)
Att sky search (11 years)	−0.007	0.963	0.993	(0.739, 1.335)
Att dual task (11 years)	−0.040	0.793	0.961	(0.711, 1.297)

Note(s): IPVAW perpetrators group (reference group was IPVAW perpetrators). OR = odds ratio; CI = confidence interval
Source(s): Authors' own creation

Secondly, the logistic regression analysis did not find evidence of an association between these neuropsychological factors and IPVAW perpetration in early adulthood. Moreover, it is important to highlight that the risk factors in the present study refer to variables that increase the likelihood of perpetrating IPVAW in early adulthood, rather than as causal factors (see Wikström and Treiber, 2017).

Previous studies have explored whether childhood executive function deficits predicted future behavioural problems, suggesting that deficits in executive function during childhood may directly contribute to later behavioural problems (Nelson *et al.*, 2019). Externalising problems, such as aggression, have been associated with a poor executive function in childhood (Ogilvie *et al.*, 2011). However, longitudinal studies on risk factors during childhood for male IPVAW perpetration are scarce, with previous research focusing on factors such as alcohol and drug consumption during adolescence, poor-quality peer networks or low socio-economic status in the family (Reingle *et al.*, 2012; Narayan *et al.*, 2014; Gomez, 2011; Costa *et al.*, 2015). Although previous systematic reviews have highlighted the relevant role of neuropsychological performance in male IPVAW perpetration (Horne *et al.*, 2020; Humenik *et al.*, 2020), no previous studies have considered

childhood neuropsychological performance as a risk factor for subsequent IPVAW perpetration (e.g. Clare *et al.*, 2021; Costa *et al.*, 2015).

In this sense, our findings did not show evidence of differences between both groups in the cognitive functions assessed during childhood and early adolescence. In addition, attention, working memory and verbal and performance IQ, evaluated at ages 8, 10 and 11, did not show evidence of increasing the likelihood of IPVAW perpetration in early adulthood in the present study. Therefore, our findings do not provide evidence that neuropsychological performance differences are present during childhood and early adolescence, nor that these factors are associated with subsequent IPVAW perpetration in early adulthood. In addition, although childhood may seem temporally distant from early adulthood, inconsistent findings exist regarding the relationship between executive functioning and the subsequent presence of externalising problems. Thus, some studies have suggested that executive functioning in early childhood may be a relatively poor predictor of externalising symptoms; however, others have found that poorer executive functioning was more strongly related to later externalising problems when children were younger rather than older (Frick *et al.*, 2019; Schoemaker *et al.*, 2013; Yang *et al.*, 2022). Therefore, neuropsychological performance in childhood could be a risk factor in adulthood, even across temporally distant periods.

On the contrary, although the results did not provide evidence that attention, working memory and IQ during childhood and early adolescence increase the likelihood of IPVAW perpetration in adulthood, the lower neuropsychological performance observed in IPVAW perpetrators compared to non-IPVAW perpetrators might develop at later stages, such as during adolescence. In reviewing research on the development of executive functioning skills, it was noted that the long developmental period of these skills might leave them vulnerable to interruption from various factors (Zelazo, 2020; Shields *et al.*, 2019). Among the variables potentially contributing to a lower neuropsychological performance of IPVAW perpetrators when they are evaluating during adulthood, can be highlighted substance abuse, the presence of traumatic brain injury (TBI) and psychopathology.

Firstly, previous studies have found that IPVAW perpetrators showed elevated levels of drug misuse, which is correlated with poorer cognitive functioning (Romero-Martínez *et al.*, 2019a, 2019b). Thus, epidemiological research indicates that drug use and abuse prevalence escalates throughout adolescence, peaking in young adulthood (Johnston *et al.*, 2008). Moreover, substance experimentation typically occurs during adolescence and significantly increases the likelihood of persistent substance use and related disorders later in life (Salmanzadeh *et al.*, 2020).

Secondly, another possible explanation could be the presence of TBI, given its established association with deficits in executive functioning (see Kunker *et al.*, 2020). In addition, previous studies found higher prevalence rates of TBI among IPVAW perpetrators than in the general population (Bannon *et al.*, 2015; Farrer *et al.*, 2012). Moreover, adolescence represents a high-risk period for acquiring a TBI. Although mild TBIs are most common, this age group is also significantly more likely to experience moderate or severe injuries (Christensen *et al.*, 2021; Dewan *et al.*, 2016). Research has found that the average age at the time of first TBI is 15.5 years (Jildeh *et al.*, 2020). The over-representation of prison inmates with a history of TBI likely indicates a significant relationship between early life TBI and criminal behaviour. Indeed, half of adolescent inmates report a history of TBI (Kaba *et al.*, 2014), and adolescents with a history of TBI exhibit significantly higher frequencies of criminal behaviour, even after controlling for age-, gender- and family-related factors (Luukkainen *et al.*, 2012). Therefore, both TBI and substance use are consequences of the pronounced increase in risk-taking behaviour that emerges during adolescence (Ilie *et al.*, 2015).

Finally, the presence of psychological disorders could directly or indirectly impair executive functioning (Friedman *et al.*, 2018; Yang *et al.*, 2022). Moreover, prior literature has found correlations between anxiety, depression, suicidal tendencies or personality disorders and the male IPVAW perpetration (Sesar *et al.*, 2018). These psychological disorders could negatively impact the executive functioning performance in male IPVAW perpetrators. Consistent with prior findings, adolescence marks a period of increased risk for the emergence or peak of mental illnesses (Casey *et al.*, 2015), with concurrent neurobiological changes during this period that may heighten the risk for psychopathology (Powers and Casey, 2015).

Considering the above, previous studies suggest that variables such as substance use, TBI and the presence of psychopathological disorders may be key determinants of the differences observed between IPVAW perpetrators and non-perpetrators in adulthood. These variables can be better understood through the biopsychosocial model (Engel, 1977; Murphy *et al.*, 2014) which integrates biological, psychological and social factors. This model posits that biological elements, such as executive dysfunctions related to TBI, neurobiological changes associated with substance use and other relevant variables such as ADHD symptoms, are considered predictors of IPVAW perpetration (see Buitelaar *et al.*, 2020; Romero-Martínez *et al.*, 2019a, 2019b; Wymbs *et al.*, 2017). These variables interact with psychological factors, such as emotional regulation, impulsivity and empathy, as well as social factors, such as child abuse and cultural norms related to IPVAW (see Debowska *et al.*, 2019; Debowska *et al.*, 2024; Golding and Fitzgerald, 2019; Humbert *et al.*, 2024; Murphy *et al.*, 2014).

Therefore, although our results showed that the neuropsychological performance assessed does not increase the likelihood of IPVAW perpetration in early adulthood, it is possible that changes in these variables may occur later in development, such as during adolescence, potentially contributing to the poorer executive functioning observed in adult males convicted of IPVAW (see Horne *et al.*, 2020; Humenik *et al.*, 2020). However, the present study was conducted with a community sample rather than IPVAW convicts. It is essential to explore this potential relationship in non-incarcerated individuals who perpetrate IPVAW to identify risk factors in different populations.

Before interpreting the implications of these findings, it is important to consider the potential limitations of the study that may have contributed to the lack of evidence. First, the study lacked adequate control of external variables that could influence the results, such as psychopathological variables. However, due to the study's design and the temporal limitations of the assessments, these had not been evaluated during childhood. Nonetheless, potentially relevant variables such as socio-economic status were controlled. Similarly, the available data from the sample is limited to psychological, physical and/or sexual violence perpetration. Unfortunately, information on controlling behaviours is not available, despite their inclusion in the definition of IPVAW (see WHO, 2021a, 2021b). Regarding the above, due to sample-related limitations, it was not possible to create sub-groups of perpetrators based on the characteristics of the violence exerted, which could have provided valuable insights given that IPVAW perpetrators constitute a heterogeneous group (see Lishak *et al.*, 2021). Finally, a self-report questionnaire was used to assess the perpetration of IPVAW, which could lead to response biases being influenced by high social desirability (Kirk, 2006). Nevertheless, similar limitations have been highlighted in previous research (e.g. Petersson and Strand, 2020). In addition, our sample was exclusively composed of [omitted information] IPVAW perpetrators of the general population, thus caution should be exercised in extending these findings to perpetrators from different countries, as intercultural variations may come into play (Bent-Goodley, 2021). In addition, it is important to consider the slightly elevated IQ scores observed in both groups, likely reflecting the unique demographic and socioeconomic characteristics of the ALSPAC cohort. ALSPAC participants tend to have higher socio-economic status and educational attainment than the general UK population, factors associated with higher cognitive performance

(Fraser *et al.*, 2013). This may limit the generalisability of our findings, as the sample may not fully represent populations with lower cognitive and socioeconomic profiles. Another limitation of this study is the 10-year gap between the neuropsychological assessments conducted during childhood (ages 8–11) and the evaluation of IPVAW perpetration in early adulthood (age 21.5). During this period, several unmeasured confounding factors, such as environmental, social and psychological changes, could have influenced the results. Unfortunately, neuropsychological assessments were not repeated during this timeframe due to the structure of the ALSPAC data set. This gap limits our ability to assess how cognitive functions might have changed over time and whether such changes could relate to IPVAW perpetration. Furthermore, the results of this study are based on a community sample and may not be directly applicable to the prison population convicted of IPVAW-related offences. Previous research suggests that incarcerated individuals often present high rates of psychopathology (e.g. personality disorders, anxiety and depression) (see Tyler *et al.*, 2019), substance misuse (Fazel *et al.*, 2017) and TBI (Williams *et al.*, 2010), which could influence neuropsychological functioning differently compared to the general population. In addition, the severity and chronicity of IPVAW perpetrated by incarcerated individuals may differ significantly from that observed in community samples, potentially impacting the generalisability of these findings to such populations. Finally, another limitation of this study is the lack of data regarding conduct problems and hyperactivity during adolescence. These variables are recognised as potentially important covariates that could provide a deeper understanding of the phenomena.

Despite these limitations, the current study has important strengths, such as its longitudinal design and the use of a sample of men from the general population to identify risk factors associated with IPVAW perpetration in early adulthood. Thus, to the authors' knowledge, this is the first study to analyse the neuropsychological performance in childhood and early adolescence of male IPVAW perpetrators at 21.5 years compared to non-perpetrators.

Therefore, it would be advisable for future research to use longitudinal designs to explore both the risk and protective factors associated with the male IPVAW perpetration. In addition, examining neuropsychological performance during the adolescence period to assess whether the findings are consistent with those of the present study during childhood would be highly relevant. Moreover, it is important that future studies should aim to include repeated neuropsychological assessments throughout this developmental period to better capture changes and account for potential confounding factors. This approach would allow for a more comprehensive understanding of the longitudinal relationship between cognitive development and IPVAW perpetration. In addition to all mentioned above, it is considered relevant to examine the potential role of substance use, TBI and psychological disorders during this developmental stage and how they might influence neuropsychological performance outcomes. Moreover, future research should consider incorporating variables such as conduct problems and hyperactivity during adolescence, as these are relevant factors that could influence neuropsychological performance and the perpetration of IPVAW. This would allow for a more comprehensive understanding of the behavioural and psychological factors that may refine and extend the current findings. Furthermore, it would be important to study the neuropsychological performance associated with different IPVAW perpetration outcomes, considering factors such as the frequency, severity, chronicity and subtypes of IPVAW exerted. Finally, expanding research to populations with a broader range of cognitive and socio-economic characteristics would also help address the sociodemographic limitations of this sample and provide deeper insights into the variability in neuropsychological functioning.

The findings of the present study hold theoretical significance by addressing a critical gap in the scientific literature. Although prior research has explored the relationship between neuropsychological performance during childhood and the later emergence of behavioural problems, such as externalising issues (e.g. Nelson *et al.*, 2019; Zelazo and Carlson, 2020), to the best of our knowledge, no studies have examined the potential association between

neuropsychological performance in childhood and early adolescence and the later perpetration of IPVAW in early adulthood. Furthermore, the results support that IPVAW and general violence may follow distinct developmental trajectories. While research on general aggression has identified deficits in childhood executive function as an early predictor (e.g. Ogilvie *et al.*, 2011), this study suggests that IPVAW perpetrators may not exhibit significant neuropsychological differences compared to non-perpetrators during childhood and early adolescence, indicating that such deficits do not constitute a risk factor for IPVAW perpetration. Finally, the findings underscore the importance of longitudinal approaches in theoretical development, highlighting how risk factors evolve over time. Theories on the aetiology of IPVAW should adopt a lifespan development, examining how risk factors emerge, develop or interact with life experiences at different developmental stages.

From a practical perspective, the findings have important implications, with the primary one being the need to redirect preventive programs that focus on neuropsychological performance. Specifically, because neuropsychological performance during childhood and early adolescence does not appear to increase the risk of subsequent IPVAW perpetration in early adulthood, preventive programmes should prioritise adolescence because it is a period during which risk factors such as substance use, psychological disorders or TBI may emerge and affect cognitive functions. In addition, preventive programmes should address the development of these risk factors, given their association with diminished neuropsychological performance and violent behaviour (e.g. Luukkainen *et al.*, 2012; Romero-Martínez *et al.*, 2019a, 2019b; Yang *et al.*, 2022). Finally, because neuropsychological performance during childhood and early adolescence does not constitute a risk factor for IPVAW perpetration in early adulthood, prevention and intervention programmes might instead focus on other critical aspects, such as emotional regulation, impulse control and social skills, which have been identified as important factors in IPVAW perpetration according to models such as the biopsychosocial model (see Engel, 1977; Murphy *et al.*, 2014).

Conclusions

In conclusion, the results showed that the groups of IPVAW perpetrators and non-IPVAW perpetrators exhibited similar neuropsychological performance at ages 8, 10 and 11 in areas such as attention, working memory and performance and verbal IQ. Furthermore, there was no evidence that any of these cognitive functions increased the likelihood of engaging in IPVAW perpetration during early adulthood.

Therefore, the deficits identified in previous studies among men convicted of IPVAW offences in adulthood, compared to non-perpetrators, do not appear to be present during this developmental stage. Thus, this poorer neuropsychological performance could emerge at later ages due to the influence of various factors, such as drug use, traumatic brain injury (TBI) and psychopathology, which are commonly associated with incarcerated populations. Finally, it would be crucial to continue studying risk factors for the perpetration of IPVAW from a longitudinal perspective to increase knowledge about the aetiology of this violence and develop effective prevention strategies.

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Data availability: The informed consent obtained from ALSPAC participants does not allow the data to be made freely available through any third-party-maintained public repository. However, data used for this submission can be made available on request to the ALSPAC Executive. The ALSPAC data management plan describes in detail the policy regarding data sharing, which is through a system of managed open access. Full instructions for applying for data access can be found here: www.bristol.ac.uk/alspac/researchers/access/ The ALSPAC study website contains details of all the data that are available (www.bristol.ac.uk/alspac/researchers/our-data/).

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