Risk Factors for Violence and Suicide in the General Population: an Umbrella Review

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General Abstract

Title: Risk Factors for Violence and Suicide in the General Population: an Umbrella Review.

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Abstract:

BACKGROUND: Violence and suicide account for an estimated 1.4 million global annual deaths. There is a large volume of literature examining single risk factors or small groups of related risk factors for violence, and separately for suicide. This thesis is an umbrella review that created an overview of this literature and compared risk factors across multiple risk categories for both violence and suicide, assessed overlap and estimated the impact of risk factors at a population level.

METHODS: A systematic search was conducted to identify reviews analysing risk factors for violence and suicide in the general population. Effect sizes were extracted and synthesized. Population attributable fractions were calculated where possible. Quality analyses were performed on reviews eligible for inclusion.

RESULTS: Twenty-two meta-analyses reporting on violence risk factors and 12 meta-analyses reporting on suicide risk factors were eligible for quantitative analysis. A further 37 reviews were included in a qualitative analysis. The strongest associations and most distinct overlap were found between neuropsychiatric risk factors for both violence and suicide, with particularly strong effect sizes found for neuropsychiatric risk factors and suicide. The neuropsychiatric risk factors which had the largest impact at a population level were substance abuse for violence (14.8%) and depression for suicide (27.9%).

DISCUSSION & CONCLUSION: This review demonstrated that neuropsychiatric risk factors for violence and suicide often have stronger associations with both outcomes than other types of risk factors, such as socio-demographic and childhood-related factors. This suggests that neuropsychiatric risk factors are of upmost importance in clinical risk assessment and as targets for intervention for violence and suicide reduction. Nevertheless, neuropsychiatric risk factors were found to account for only a small proportion of violence at a population level and appeared to have a stronger impact on suicide. Risk assessment for violence and suicide is complex and will always be imperfect. Further research is required to elucidate the areas of uncertainty found by this review.

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Abbreviations and symbols used in Figures and Tables

- CI = Confidence Interval
- OR = Odds Ratio
- ES = Effect Size (Odds ratio, relative risk or standardized mortality ratio)
- (O)* = Observed effect size, or overall effect size of meta-analysis
- (E)** = Expected effect size, or effect size of the largest included study in each meta-analysis
- I (error bar) = 95% confidence intervals
- SMR = Standardised Mortality Ratio

Chapter 1 – Introduction

1.1 Introduction

Violence and suicide undoubtedly have significant impacts on individuals and society. Global deaths per year are estimated at 500,000 for interpersonal violence and 900,000 for suicide.[1] In addition to substantial mortality, many more people suffer from non-fatal injuries as results of self-harm and interpersonal violence, with subsequent increased risk of mental and physical health complications.[1] Violence, including self-directed and interpersonal violence, is thought to be among the leading causes of death worldwide for people aged 15-44 years of age.[1]

Due to their significant mortality and morbidity, improved clarity on the strength of associations between risk factors for violence and suicide is important and merits further research. Such work can aid our understanding of causes, improve risk assessment and identify targets for intervention.

In addition to examining the strengths of associations between risk factors and outcomes, this review will examine the impact of risk factors at a population level. The reason for this additional investigation is that strength of association between risk factors and the outcomes of violence or suicide is important but not a complete representation. In the case of a rare risk factor, which is very strongly related to the outcome of violence or suicide, the overall impact of this risk factor on the general population will be relatively small. Conversely, a very common risk factor with an unremarkable strength of association with violence or suicide could potentially have a large impact at a population level. An example of this can be seen later in this review when bipolar disorder and depression as risk factors for suicide are

compared. Bipolar disorder had the larger effect size of the two, but depression, due it its higher prevalence, had a larger impact at a population level.

To date, reviews examining risk factors for violence or suicide have often taken an individual risk factor, for example, bipolar disorder or schizophrenia, and reviewed the strength of association between the individual risk factor and either violence or suicide.[2, 3] A number of reviews have also focused on a cluster of related risk factors, for example, personality disorders or family problems, and reviewed these groups of related risk factors and their association with either violence or suicide risk.[4, 5]

This umbrella review (also known as a meta-review) will compare and combine reviews on multiple different risk factors for both violence and suicide. The methodology of umbrella review was chosen for several different reasons. Firstly, umbrella review methodology uses a transparent and reproducible systematic search strategy. This minimises the risks of error and bias associated with the alternative methodology of narrative review.[6] Using a systematic search strategy is also helpful in identifying gaps in the current literature and highlighting areas for further research.[7] Importantly, umbrella review methodology provides a broad overview of current research evidence by its integration of results from multiple different systematic reviews and meta-analyses.[6] To the best of my knowledge, there is no current overview of risk factors across multiple risk categories combining violence and suicide.

1.2 Aims

The aims of this umbrella review were threefold. Firstly, the review aimed to systematically examine and give a broad overview of risk factors for violence and suicide in the general population. Secondly, it aimed to compare effect sizes for risk factors across multiple different risk categories and assess to what extent risk factors for violence and suicide

overlap. Finally it aimed to estimate the impact of risk factors for violence and suicide at a population level.

Chapter 2 – Methods

2.1 Search Strategy

Three databases were searched from their start dates: PsycINFO (1806 - 1st of February 2014), Medline (1946 - 1st of February 2014) and Global Health (1973 - 1st February 2014). Search protocols were designed to find relevant reviews on both risk factors for violence and suicide. Google Scholar (2004 – 15th of January 2015) and PubMed (1996 – 15th of January 2015) were also utilized for targeted searches.

The following keywords were used for violence: 'violen*, crim*, offen*, antisocial and delinq*'. These terms were combined with search terms for risk factors ('Risk, predict*') and search terms for desired review types ('meta*, systematic review').

A separate search was carried out to identify risk factors for suicide. The following keywords were used: 'suicid* and suicide' combined with 'meta* and systematic review'.

Supplementary targeted searches were used to identify additional studies. Risk factors selected for searches in a targeted manner were those, which were cited in more general literature, but not found with the initial search protocol. Examples of these factors included; autism, dementia, learning disability and conduct disorder for violence, as well as a range of psychological risk factors for suicide. Citations and reference lists of relevant reviews were hand-searched. Direct searches by authors' names as well as by specific risk factors were also conducted. All first author names on included reviews were searched separately to assess if they had any further publications that were eligible for inclusion in this review.

2.2 Study Eligibility

Eligible studies were: (a) meta-analyses, meta-reviews or systematic reviews that examined risk factors for violence or suicide in the general population; (b) reviews with sufficient data

to calculate an effect size with 95% confidence intervals; (c) reviews examining risk factors for violence were included for broad-ranging types of violence, such as violent crime, delinquency, sexual violence and antisocial behaviour; (d) For suicide, only reviews that used completed suicide as the outcome measure were included in the main results section; (e) both published and unpublished reviews in any language were considered. (f) Reviews that examined risk factors for violence and suicide, which were unable to provide a quantitative estimate of effect size, were included in a separate qualitative results section for discussion only.

Articles with methodologies other than meta-analysis, meta-review or systematic review, such as empirical studies or randomized controlled trials, were excluded. Due to our focus on risk factors for violence and suicide in the general population, reviews that examined these risk factors in specific groups, for example, studies which examined prisoners only or individuals with a specific diagnosis only, were excluded.[8, 9] Recidivism reviews and reviews that examined interventions for violence or suicide were also excluded.[10, 11, 12] Reviews that examined self-harm or attempted suicide, but did not review completed suicide were excluded from the main results section.[13] Relevant reviews that did not provide effect sizes were excluded from the main results section but discussed later in a second results section.[14,, 15] If more than one eligible review was found on the same risk factor, only the most recently published review was included. Inclusion and exclusion criteria have been summarized in Table 1.

Inclusion Criteria	Exclusion Criteria
Design: Meta-analyses, meta-reviews and systematic reviews that examine risk factors for violence or suicide in the general population	Empirical studies and randomized controlled trials were excluded.
Reviews with enough data to calculate effect sizes with 95% confidence intervals. Reviews without effect sizes, deemed to be relevant, were included for discussion in a separate qualitative results section,	Reviews that examined risk factors for violence and suicide in groups other than the general population, for example, studies which examined prisoners only, were excluded
Outcome 1: Reviews covering broad definitions of violence were included. Examples of forms of violence included were: violent crime, delinquency and antisocial behaviour.	Reviews that examined self-harm or attempted suicide, but did not review completed suicide were excluded from quantitative synthesis.
Outcome 2: For suicide, only reviews that used completed suicide as the outcome measure were included in the main results section	Reviews that did not provide quantitative estimates were excluded from data synthesis. (However, relevant reviews were included in a separate qualitative results section for discussion).
Reviews in any language and published at any date prior to the last date of the search (1st of February 2014 for systematic search and 15th of January 2015 for targeted search). Unpublished reviews, such as doctoral theses, were also considered.	Recidivism reviews and reviews that examined interventions for violence and suicide were excluded. If more than one review was found on the same risk factor, the older of the review(s) was/were excluded

Table 1 - Inclusion and Exclusion Criteria for Quantitative Synthesis

2.3 Data Extraction and Quality Assessment

Data were extracted and transcribed onto a standardised form. The original effect sizes with 95% confidence intervals were recorded along with information on the number of studies, total number of cases, year of publication, risk factor examined and outcome measures used in each review. Extracted data were cross-checked by a post-doctoral student in the forensic research group.

Reviews were assessed for quality using the 'Assessing the Methodological Quality of Systematic Reviews' ('AMSTAR') tool.[16, 17] Details of this scoring system are outlined in Table 2. Scores of 0 to 3 are considered low, 4 to7 medium, and 8 to 11 high.[17, 18]

Question	Score '1' or '0'
1. Was an a priori design provided?	
2. Was there duplicate study selection and data extraction?	
3. Was a comprehensive literature search performed?	
4. Was 'grey' (unpublished) literature considered?	
5. Was a list of studies (included and excluded) provided?	
6. Were the characteristics of the included studies provided?	
7. Was the scientific quality of the included studies assessed and documented?	
8. Was the scientific quality of the included studies used appropriately in formulating conclusions?	
9. Were methods used to combine the findings of studies appropriate?	
10. Was the likelihood of publication bias assessed?	
11. Were conflicts of interest stated?	
Total out of 11	

Table 2 - Assessing the Methodological Quality of Systematic Reviews Scoring System

From each meta-analysis, separate effect sizes for gender were extracted when possible. Data were also collected on the effect size of the largest study included in each meta-analysis as well as the effect size for different study methods included, for example, the effect size for prospective studies alone. When this data were not available in reviews, authors were contacted and requested to provide this information.

2.4 Statistical Analysis – Effect Sizes

The methods used for expressing effect sizes varied between eligible reviews. Effect sizes used in eligible reviews were reported in all of the following ways: Odds ratios (ORs), Cohen's d, correlation coefficients, relative risks (RRs) and standardized mortality ratios (SMRs). In order to compare the strength of association between different risk factors and violence or suicide, effect sizes were converted to comparable units.

2.5 Effect Sizes and Reviews - Risk Factors for Violence

For reviews on risk factors for violence, all effect sizes that were not originally expressed as ORs were converted to ORs. For effect sizes reported as Cohen's d, log transformed odds

ratios were calculated from Cohen's d.[18] Effect sizes reported as correlation coefficients, they were converted first to Cohen's d and then to log transformed odds ratios.[18] Formulae used are outlined in Appendix A.

All effect sizes were presented on forest plots as ORs. The reference values used for ORs were as follows; ORs of 1.0-1.5 were considered weak, while ORs between 1.6 and 2.5 were considered moderate. ORs of 2.6-9.9 were considered strong, while ORs of 10.0 and above were considered to be very strong.[19]

2.6 Effect Sizes and Reviews - Risk Factors for Suicide

Effect sizes for risk factors for suicide were expressed as ORs, RRs, Cohen's d or SMRs. For effect sizes reported as Cohen's d, log transformed odds ratios were calculated directly from Cohen's d with the same method outlined above for Cohen's d effect sizes for violence.[18] RRs and SMRs were considered comparable to the ORs and effect sizes were combined in the same forest plots. This was considered reasonable as the RRs and SMRs would provide a figure close to, or at worst, slightly more conservative than the OR.[20, 21, 22] It was decided not to try to convert all effect sizes to RRs as this would have required accurate data on prevalence of risk factors, which in some cases, was not available.

All analyses were performed using STATA-IC version13 and Microsoft Excel 2010.

2.7 Categorization of Risk Factors and Outcome Measures

In order to aid clarity and comparison between violence and suicide, risk factors and outcome measures were qualitatively analysed following completion of the search for eligible reviews. Risk factors were assessed for common themes running between them. For example, risk factors in the forms of experiences, actions or exposures that occurred in a person's past, such as previous antisocial behaviour, suicide attempts in the past and being the victim of bullying in childhood, were all categorized as 'historic risk factors'.

With respect to violence only, results were separated into different categories of outcome measures for violence when clear distinctions were evident. Reviews examining the specific outcome measures of intimate partner violence, sexual violence and homicide were analysed separately from reviews using outcome measures of more general forms of interpersonal violence.

2.8 Population Attributable Fractions

In addition to testing the strength of association between exposure to risk factors and violence or suicide, we attempted to estimate the proportion of cases that can be attributed to each risk factor in the general population. Although causal association cannot be claimed between each risk factor and violence or suicide, population attributable fractions (PAFs) were utilized to estimate the impact that each risk factor has at a population level by taking into account the risk factors' prevalence. If a risk factor has a high RR but low prevalence, its impact at a population level may be lower than a risk factor, which has a low or moderate RR but has a high prevalence.[23] An example of this is seen later in this review, when depression has a higher PAF than bipolar disorder, despite bipolar disorder having a stronger association with suicide than depression (Figure 10). Please see Appendix A for PAF formula.

Chapter 3 – Results

Results are presented in two sections. The first section comprises the main body of results, namely relevant reviews that were eligible for quantitative analysis. This section also contains five separate quality tests on included reviews. The second section addresses reviews for both violence and suicide, which were deemed relevant to this review, but which were not compatible with quantitative analysis.

3.1 Main Results

A systematic search yielded 22 meta-analyses on violence risk factors and 12 meta-analyses on suicide risk factors, which were eligible for data synthesis (Figure 1, Figure 2).[2-5, 23-52]

In excess of 160,000 cases were included from approximately 1300 studies taken from 23 different countries. Forty separate risk factors for violence and suicide were quantitatively analysed. Characteristics of these included reviews can be found in appendices ‘B’ to ‘J’. A further 20 reviews for violence and 17 reviews for suicide were eligible for discussion, but were not compatible with quantitative analysis. These reviews are discussed separately.

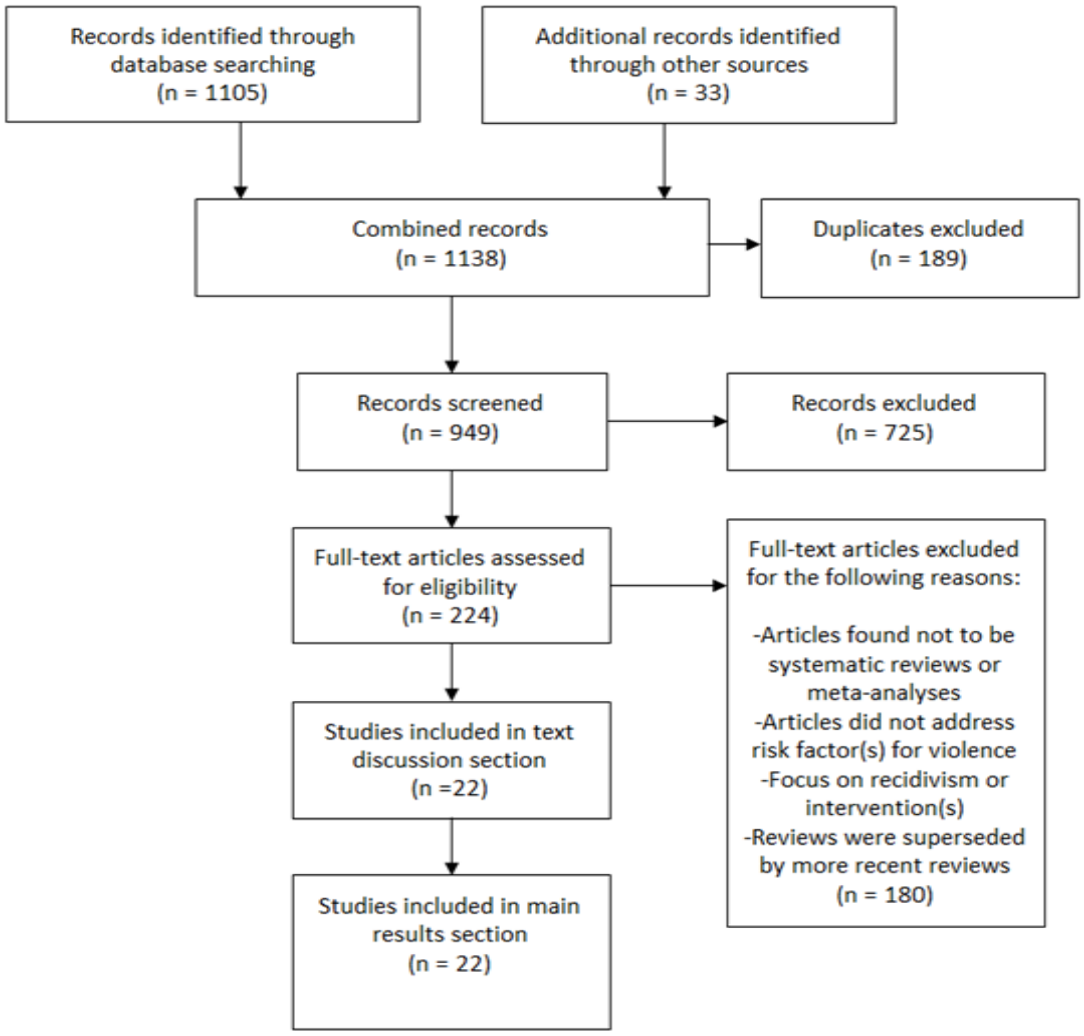

Figure 1 - Flow Chart of Systematic Search Strategy for Risk Factors for Violence

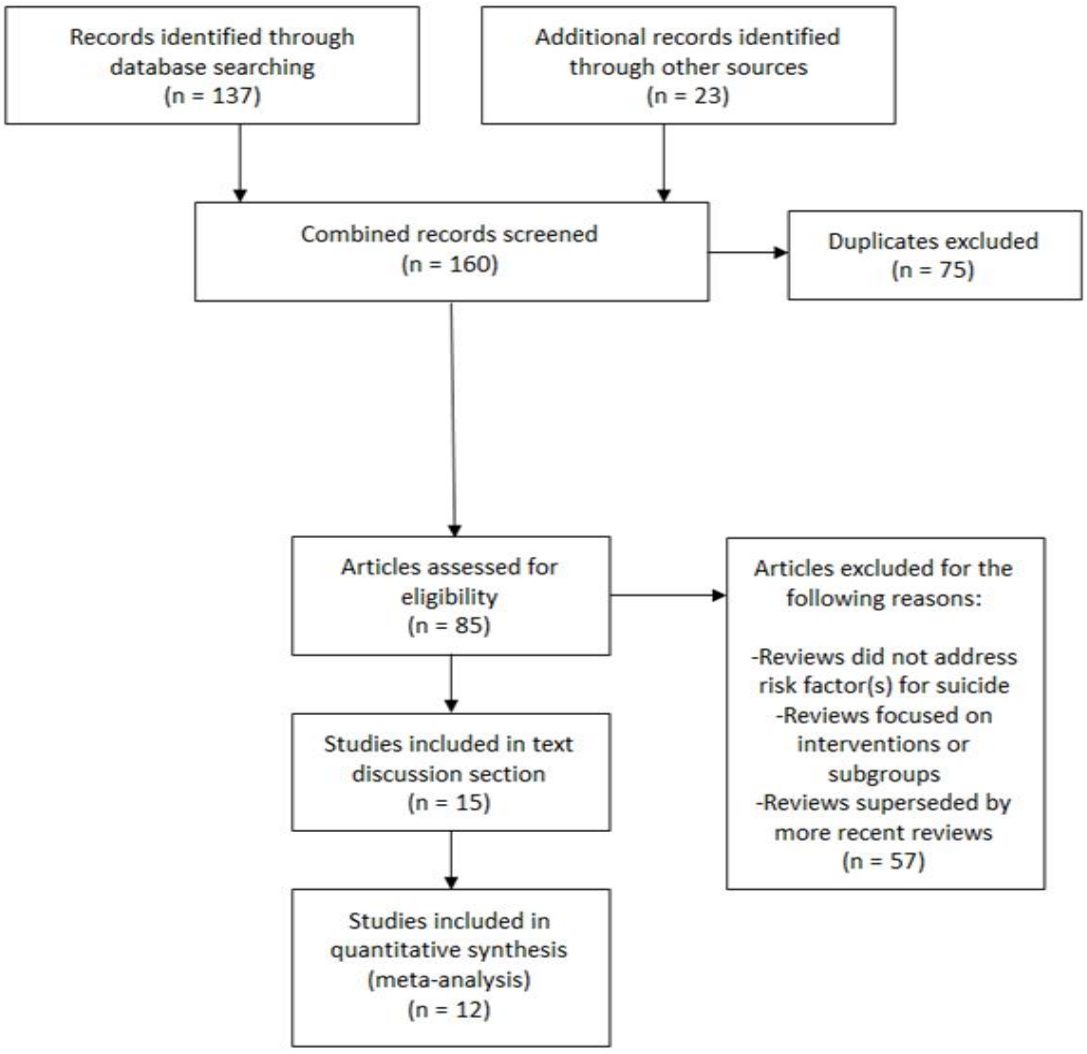

Figure 2 - Flow Chart of Systematic Search Strategy for Risk Factors for Suicide

Risk factors could be grouped into broad categories or domains. Violence studies were grouped into neuropsychiatric, historic, parental and psychological domains (Figure 3). Suicide studies were grouped into neuropsychiatric, environmental and historic domains (Figure 4). Heterogeneity was taken into account, as advised by Higgins.[53] Due to high heterogeneity, (I^2 in excess of 90% for both suicide and violence studies), results were not pooled.

3.1.1 Risk Factors for Violence and Suicide - Overview

The largest effect sizes were found in the neuropsychiatric category. This was true for studies on risk factors for both violence and suicide. Of the eight neuropsychiatric risk factors analysed for violence, six overlapped with those for suicide. Less defined overlap was found for environmental, parental and historic risk categories. No overlap between psychological risk factors was found. Psychological risk factors for suicide are discussed separately.

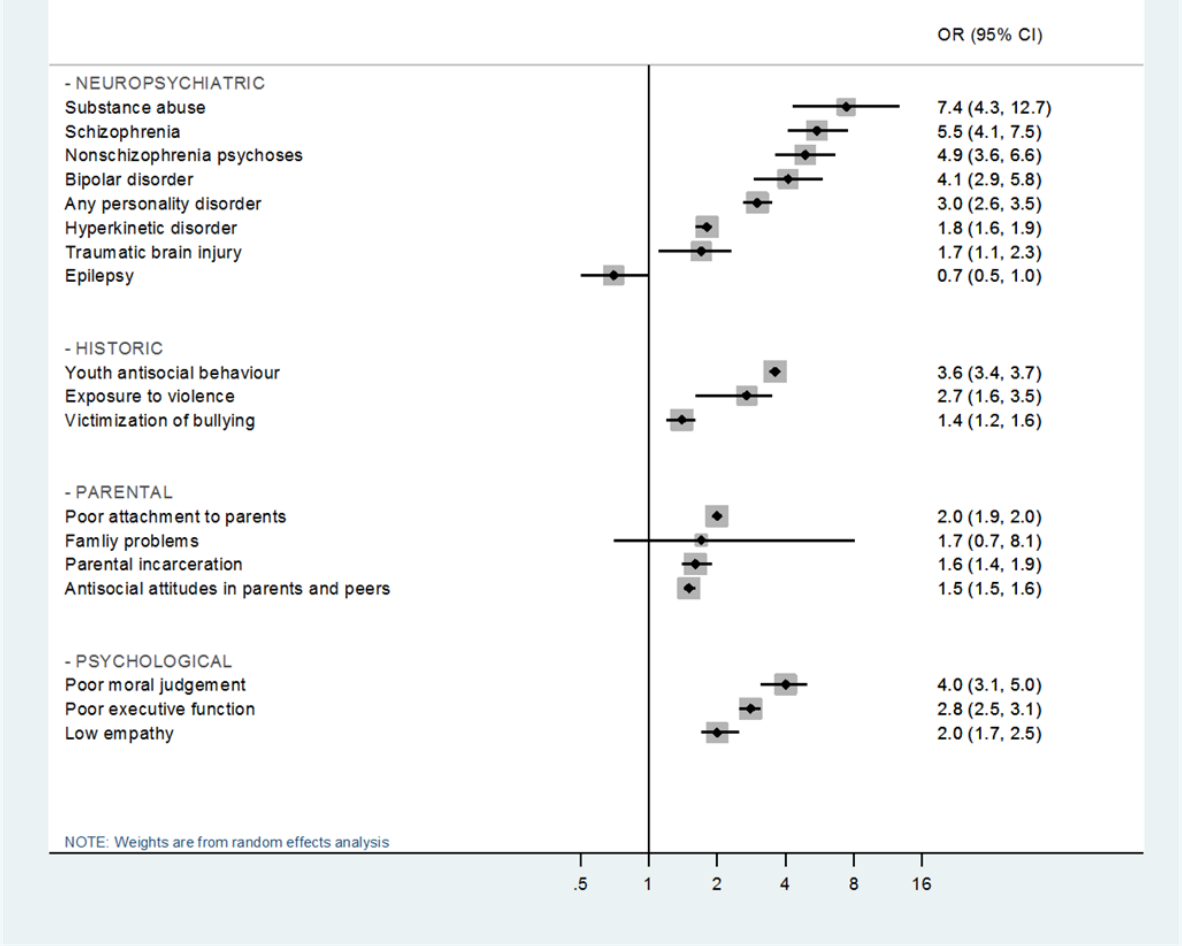

Figure 3 - Risk Factors for Violence - Overview

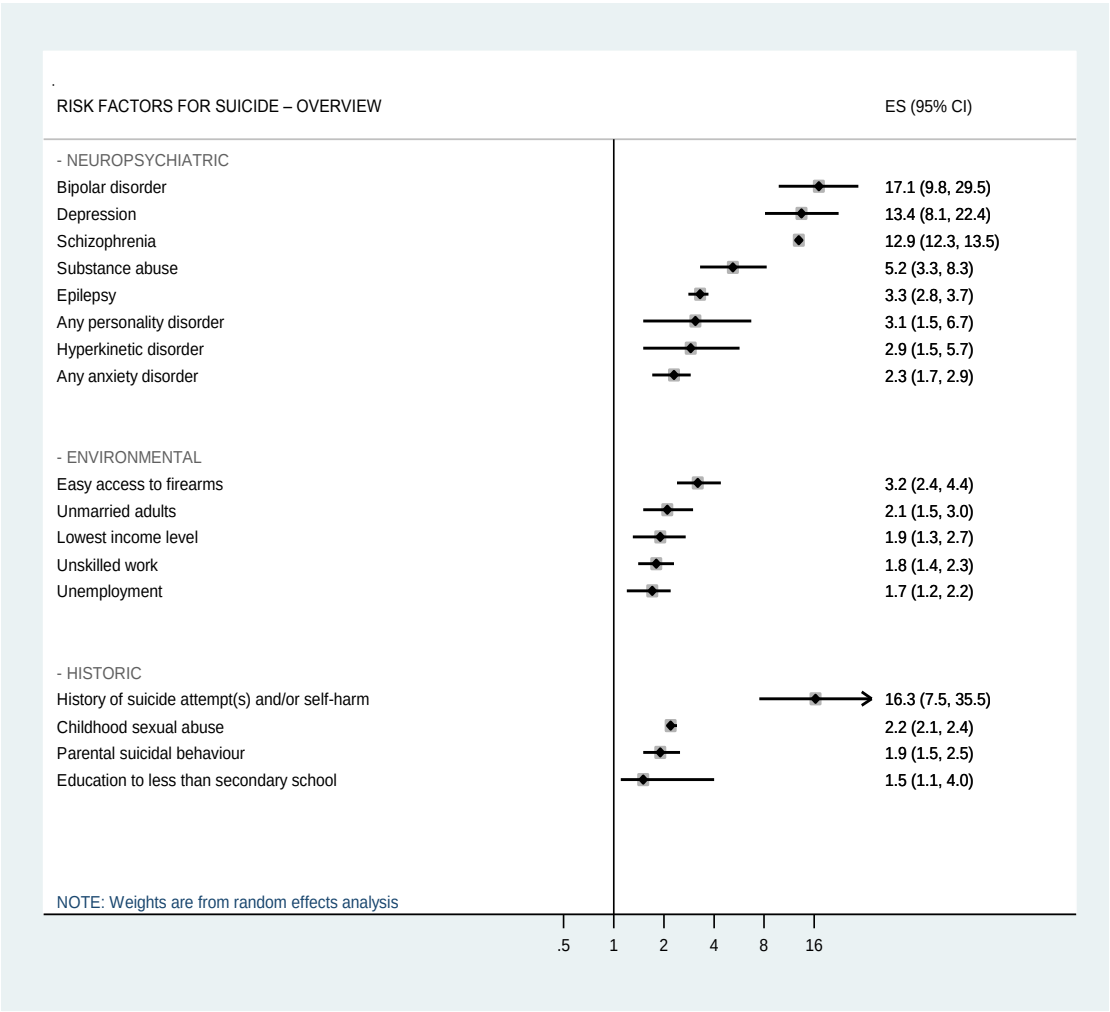

Figure 4 - Risk Factors for Suicide - Overview

3.1.2 Risk Factors for Intimate Partner Violence

A subgroup of reviews focused solely on intimate partner violence (Figure 5).[35-39] Some risk factors for intimate partner violence overlapped with risk factors for general violence (Figure 3), such as substance abuse and exposure to violence. Other risk factors for intimate partner violence appeared to be specific to relationships, such as marital dissatisfaction and past emotional, verbal and sexual abuse by one partner to another (Figure 5).

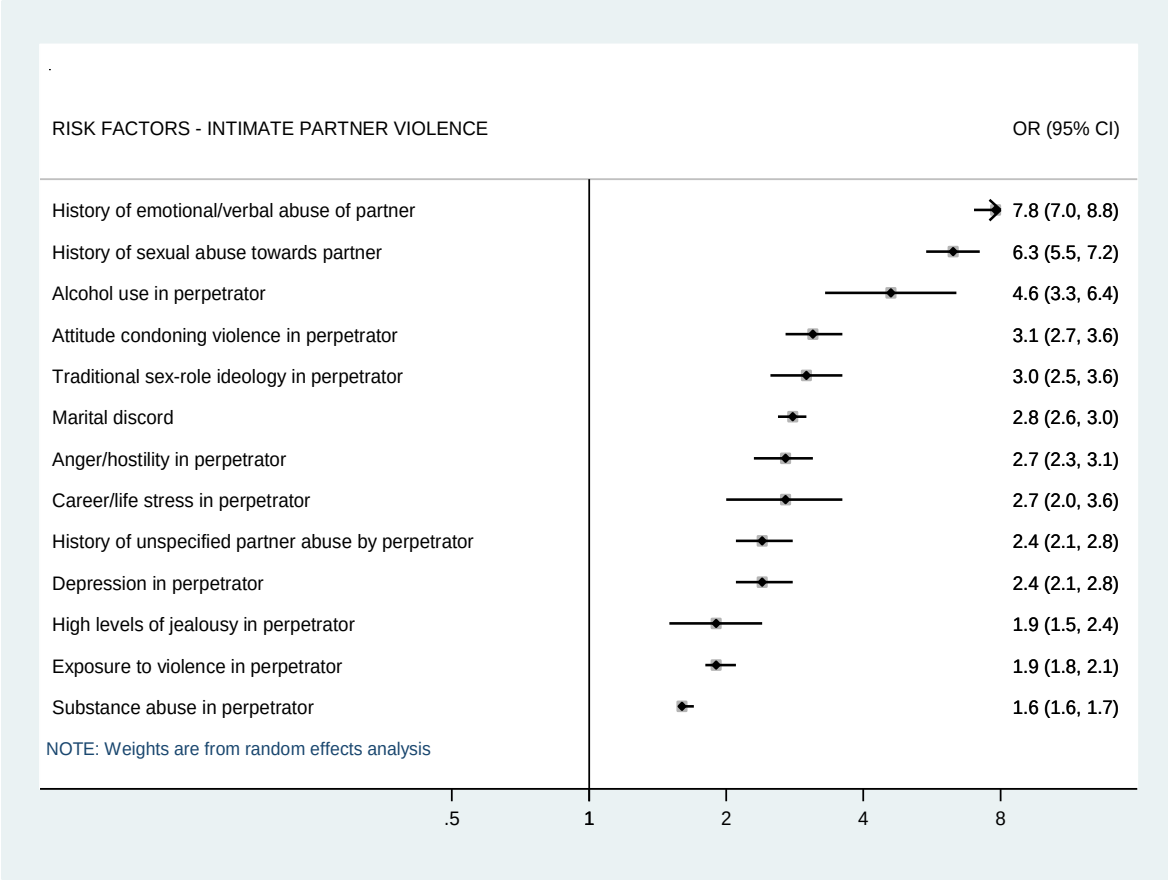

Figure 5 - Risk Factors - Intimate Partner Violence

3.1.3 Risk Factors for Sexual Violence and Homicide

Two eligible reviews provided data for risk factors for perpetration of sexual violence alone, while only one eligible review provided separate risk estimates for perpetration of the outcome of homicide alone (Figure 6).[24, 41]

Risk factors for sexual violence perpetration included externalizing behavioural problems, which incorporated aggression, substance abuse, personality disorders (cluster B) as well as past criminal convictions. Internalizing behavioural problems included issues such as; mental illnesses, personality disorders (cluster A) and low self-esteem. Social problems referred to deficits in empathy and social skills, social isolation and relationship problems.

Risk factors for sexual violence broadly overlapped with risk factors for general violence (Figure 3) and intimate partner violence (Figure 5). The only risk factor specific for sexual violence was the risk factor of 'sexual problems', which incorporated the use of sexual activity as a coping mechanism and paraphilia. Limited data were available for risk factors for homicide alone. For the risk factors found (schizophrenia and substance abuse), both overlapped with risk factors for general violence (Figure 3).

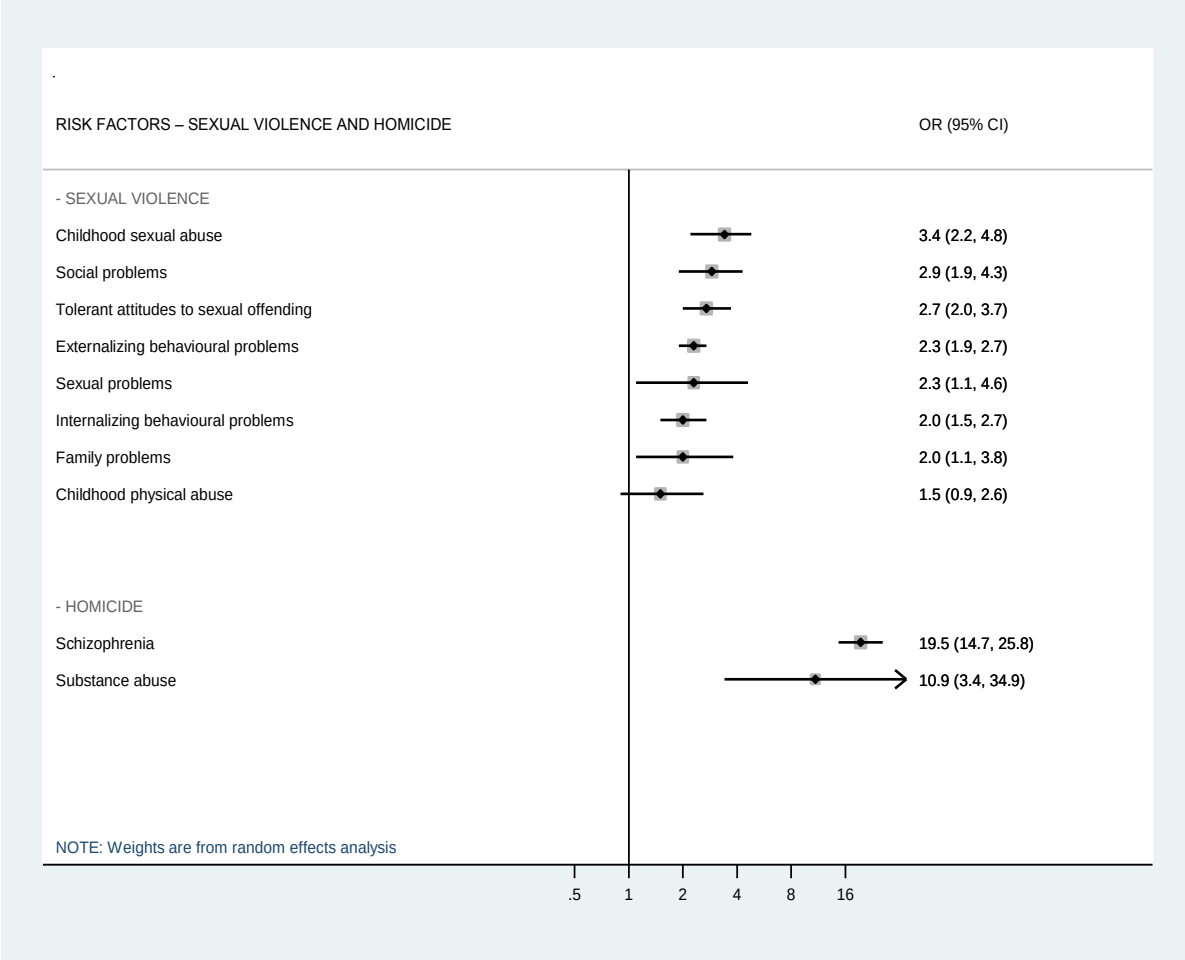

Figure 6 - Risk Factors - Sexual Violence and Homicide

3.1.4 Risk Factors Stratified by Gender

Where possible, results were stratified by gender for both violence and suicide (Figure 7, Figure 8). It is acknowledged that not all eligible reviews contained sufficient data to stratify

results by gender. Effect sizes for females were larger than for males for all of the four neuropsychiatric violence risk factors (Figure 7). On stratification of results by gender for suicide, it was noted that effect sizes were equal or larger for males than for females in six out of eight cases (Figure 8). The two effect sizes that were larger for suicide in females than for suicide in males were both in the neuropsychiatric risk category, namely depression and substance abuse. It was possible to stratify one effect size for intimate partner violence by gender.[36] For the risk factor of both high levels of marital discord and low levels of marital satisfaction, the combined pooled effect size was equivalent to an OR of 2.8 (with a 95% confidence interval estimate of 2.6 – 3.0). Males alone had an effect size equivalent to an OR of 2.9, while females alone had an effect size of an approximate OR of 2.2. This was result was excluded from the results forest plot due to insufficient available data to calculate 95% confidence intervals.

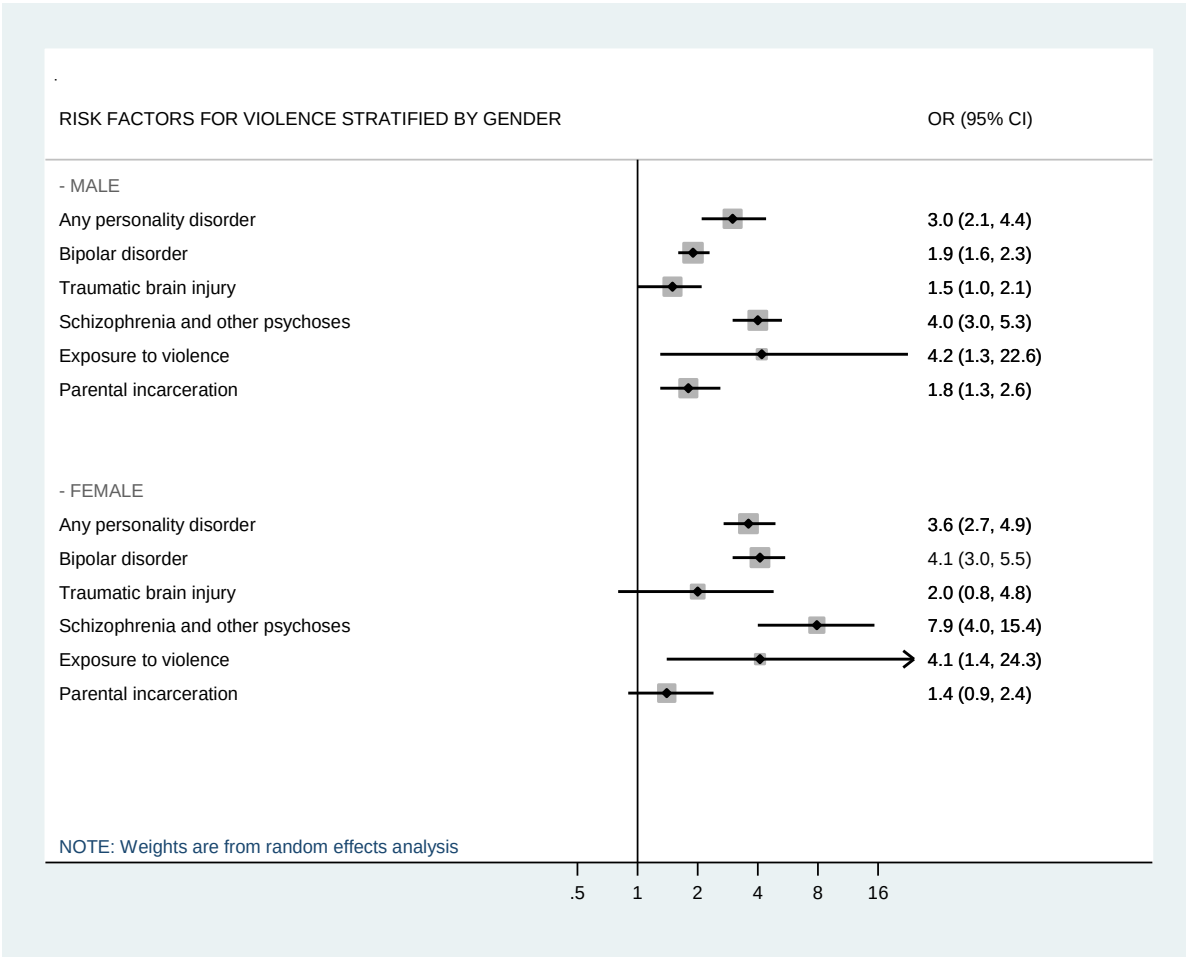

Figure 7 - Risk Factors Stratified by Gender

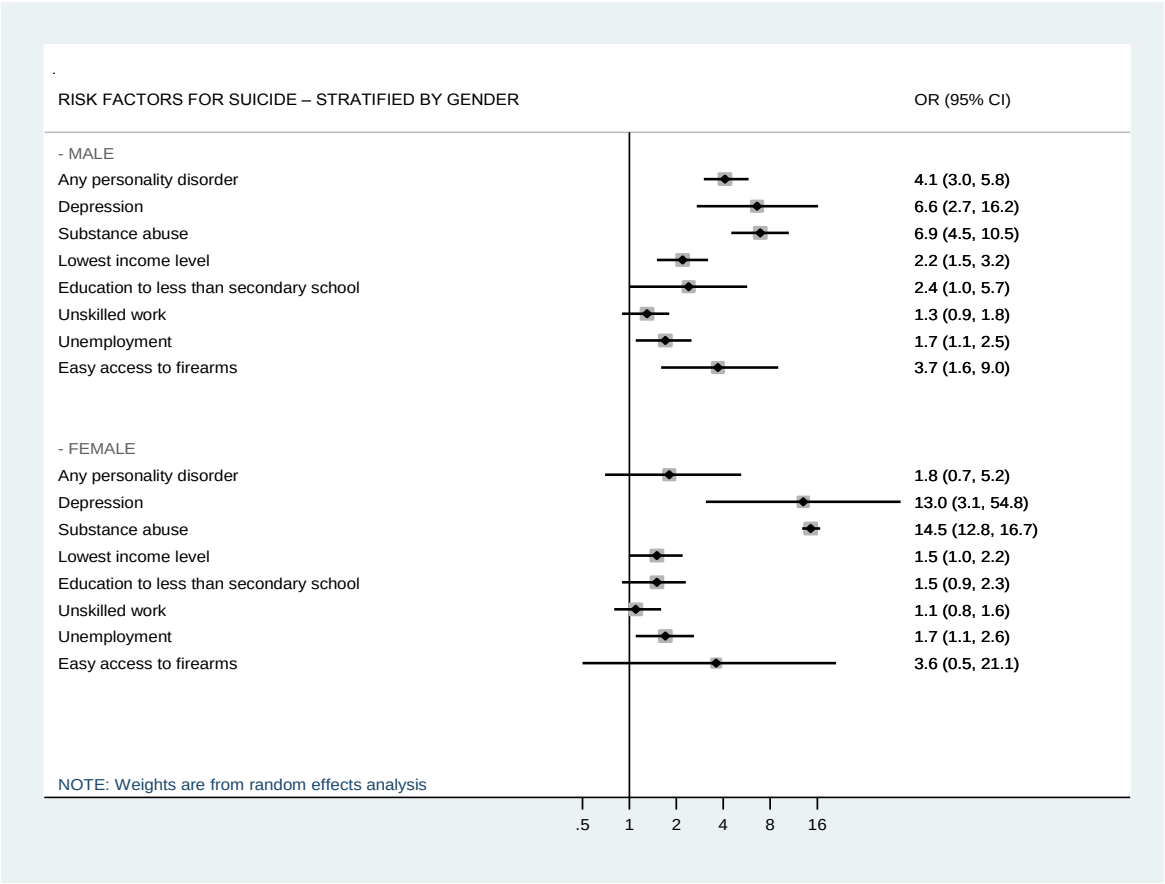

Figure 8 - Risk Factors for Suicide Stratified by Gender

3.1.5 Population Attributable Fractions

Population attributable fractions (PAFs) act as an estimate of the proportion of cases that can be attributed to a risk factor.[21] PAFs assume a causal link between a risk factor and an outcome. Although a definite causal link between the risk factors discussed here and the outcomes of violence and suicide cannot be claimed, PAFs were calculated to provide a rough estimate of the impact each risk factor may have at a population level. PAFs take into account a risk factor's prevalence. It was only possible to calculate PAFs for risk factors, which had high quality data available on their prevalence.

To aid transparency, the prevalence estimates for risk factors have been listed in Table 3 and Table 4 below. These tables also display the results for PAFs for violence and suicide

respectively. To aid clarity, supplementary figures have been included with PAF results alone displayed as bar charts (Figure 9 and Figure 10).

The most accurate, up-to-date and generalizable prevalence estimates were sought. Estimates of prevalence using data from multiple worldwide or pan-European studies were prioritized.[54, 56, 58] For risk factors, which did not precisely match with high quality prevalence estimates, for example, the prevalence estimate in Wittchen's study [56] is for general psychotic disorders, in contrast to the specific risk factors, found by this review, of 'non-schizophrenia psychosis' and schizophrenia.[3, 24] In situations such as these, it was necessary to take prevalence estimates from smaller studies, which more closely resembled the risk factor under examination.[55] Prevalence estimates quoted in included meta-analyses were occasionally cited if they were deemed the highest quality available evidence that was most similar to the risk factor in question.[3, 4, 28]

The highest PAFs for violence were found to be substance abuse, exposure to violence and personality disorders respectively (Table 3 and Figure 9). For suicide, highest PAFs were found for previous suicide attempts or self-harm, depression and personality disorders (Table 4 and Figure 10).

Risk Factor for Violence	Prevalence Estimate % and Range (if published)	Prevalence Estimate Taken from Study	Type of Prevalence Estimate	Relative Risk for violence with 95% CI	Population Attributable Fraction (%) with 95% CI
Substance abuse	3.4 (2.7 - 4.2)	Steel [54]	Lifetime	6.1 (3.9 - 9.1)	14.8 (9.0 - 21.6)
Schizophrenia	0.4 (0.2 - 1.2)	Saha [3]	Lifetime	5.4 (4.1 - 7.3)	1.7 (1.2 - 2.5)
Nonschizophrenia psychoses	2.2	Perala [55]	Lifetime	4.4 (3.4 - 5.7)	7.0 (5.0 – 9.4)
Any personality disorder	9.0 (4.0 – 13.0)	Yu [4]	Not stated	2.5 (2.3 - 2.9)	11.9 (10.5 - 14.6)
Bipolar disorder	0.9 (0.2 – 1.1)	Wittchen [56]	12-month	3.7 (2.9 - 4.9)	2.4 (1.7 – 3.4)
Traumatic brain injury	12.0	Frost [57]	Not stated	1.6 (1.1 - 1.7)	6.7 (1.2 - 7.7)
Hyperkinetic disorder	5.3	Polanczyk [58]	Not stated	1.7 (1.6 - 1.8)	3.6 (3.1 - 4.1)
Victimization of bullying	34.0	Craig [59]	“Couple of months”	1.2 (1.1 - 1.3)	6.3 (3.3 - 9.3)
Exposure to violence	70.0	Wilson [28]	Not stated	1.2 (1.1 - 1.3)	12.2 (6.5 - 17.4)

Table 3 - Population Attributable Fractions of Risk Factors for Violence

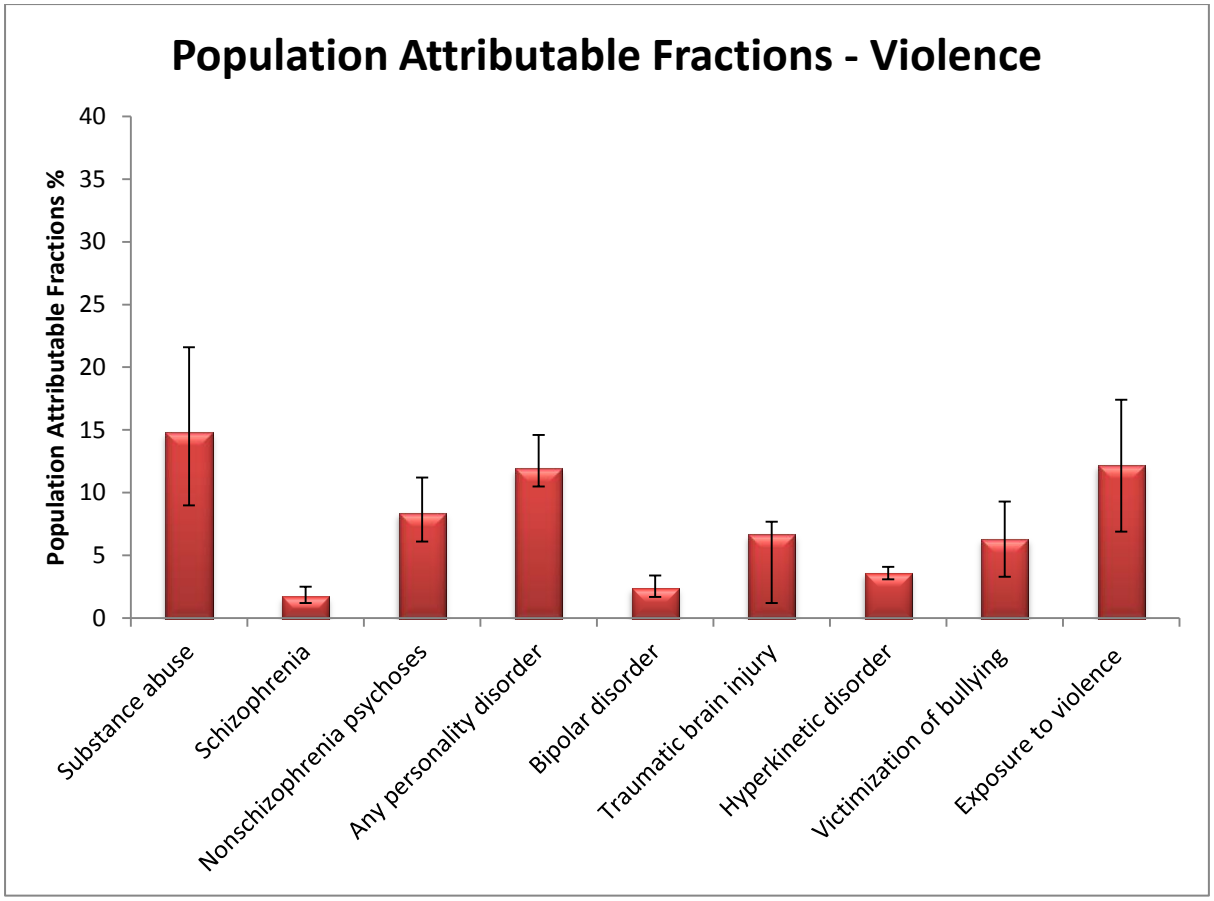

Figure 9 - Population Attributable Fractions for Violence

Risk Factor for Suicide	Prevalence Estimate % and Range (if published)	Prevalence Estimate Taken from Study:	Type of Prevalence Estimate	Relative Risk for suicide with 95% CI	Population Attributable Fraction with 95% CI
Bipolar disorder	0.9 (0.2 – 1.1)	Wittchen [56]	12-month	17.1 (9.8 - 29.5)	12.7 (7.3 – 20.4)
Schizophrenia	0.4 (0.2 - 1.2)	Saha [3]	Not stated	12.9 (12.3 - 13.5)	4.5 (4.3 - 4.8)
Depression	6.9 (3.1 – 10.1)	Wittchen [56]	12-month	6.6 (5.1 - 8.1)	27.9 (11.3 – 32.9)
Substance abuse	3.4 (2.7 - 4.2)	Steel [54]	Lifetime	4.6 (3.1 - 6.7)	10.9 (6.7 – 16.2)
Epilepsy	0.6	Forsgren [65]	Not stated	3.3 (2.8 - 3.7)	1.4 (1.1 - 1.6)
Any personality disorder	9.0 (4.0 – 13.0)	Yu [4]	Not stated	3.0 (1.9 – 5.5)	15.3 (7.5 - 28.8)
Hyperkinetic disorder	5.3	Polanczyk [58]	Not stated	2.9 (1.5 – 5.7)	9.1 (7.4 – 19.9)
Any anxiety disorder	12.9 (11.3 - 13.7)	Steel, [54]	Lifetime	2.0 (1.6 – 2.4)	11.4 (7.2 – 15.3)
Suicide attempt(s) and/or self-harm	5.6 (suicide attempt) 4.9 (self-harm)	McManus [60]	Not stated	8.8 (5.5 – 12.1)	30.4 (26.7 – 38.3) 27.7 (18.1 – 35.2)
Childhood sexual abuse	13.0	Pereda [61]	Not stated	1.9 (1.8 – 2.0)	10.5 (9.4 – 11.5)

Table 4 - Population Attributable Fractions of Risk Factors for Suicide

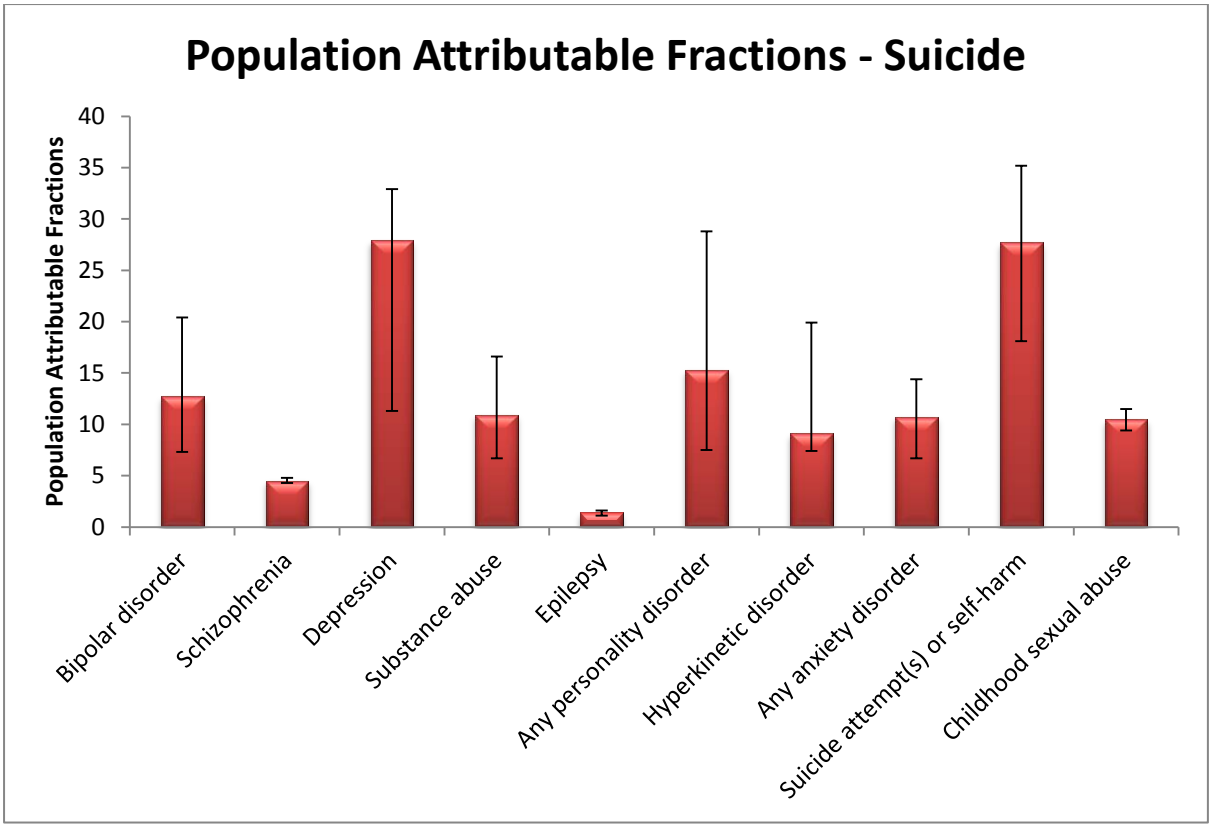

Figure 10 - Population Attributable Fractions for Suicide

3.1.6 Quality Assessments of Included Reviews

3.1.6.1 Assessment 1

Each eligible review was assessed and scored using the 'Assessing the Methodological Quality of Systematic Reviews' or 'AMSTAR' tool. To recap, Scores of 0 to 3 are considered low, 4 to 7 medium, and 8 to 11 high.[17] A copy of the full AMSTAR tool is included in the Methods Section. Only one review fell into the category of 'low' (Figure 11). Of the remaining 33 included reviews, 22 fell in the high scoring category, while 11 fell in the medium scoring category. Further details of AMSTAR scoring for individual reviews can be found from Appendix B onwards.

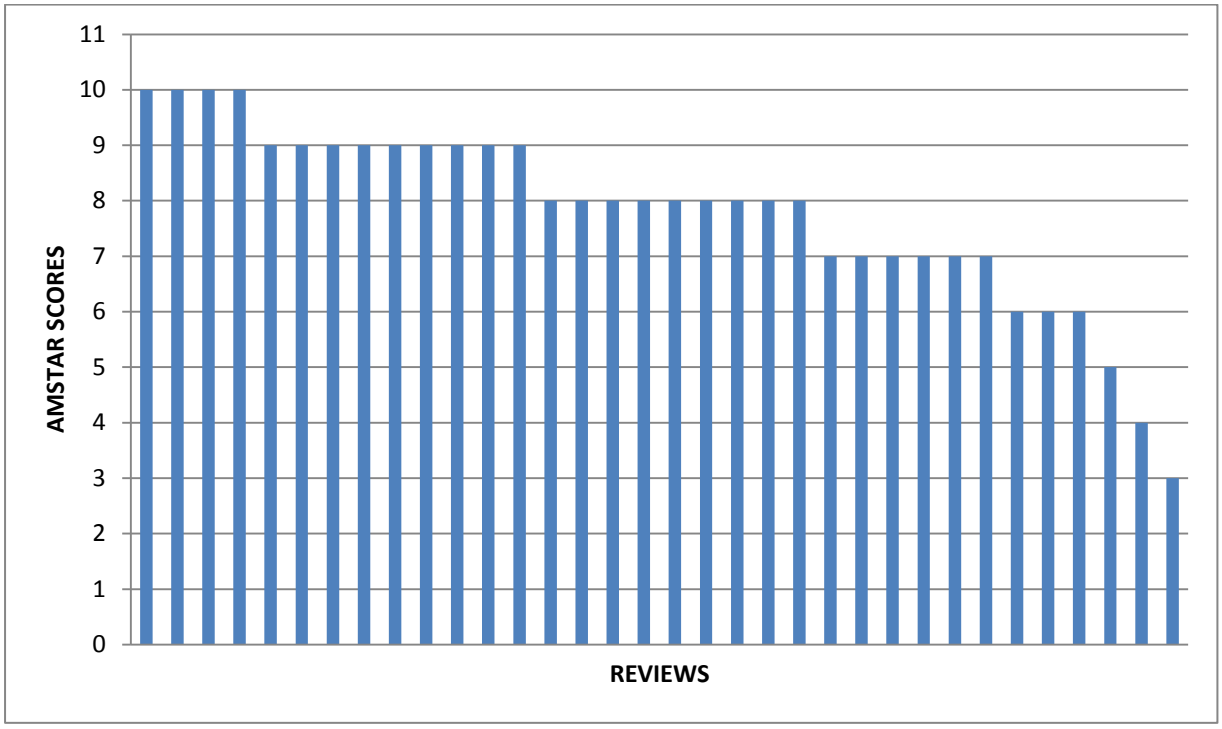

Figure 11 - AMSTAR Scores for Included Reviews – Each bar represents a one review. Individual review AMSTAR scores are detailed in Appendices B-J

3.1.6.2 Assessment 2

It was assumed that the largest included study in each meta-analysis was the most precise and thus closest to the 'true' effect size.[62] The relationships between the overall effect sizes quoted for each meta-analyses and the effect size of the largest study included in each meta-analysis were analysed (Figure 12). The majority of results (approximately 80%) indicate that the effect size quoted in the meta-analysis is larger than the effect size quoted in each meta-analysis' largest included study (Figure 12). The 45 degree line denotes the points of equality between the largest study effect size and overall meta-analysis effect size. Two outliers have been removed. Axes are in logarithmic scales.

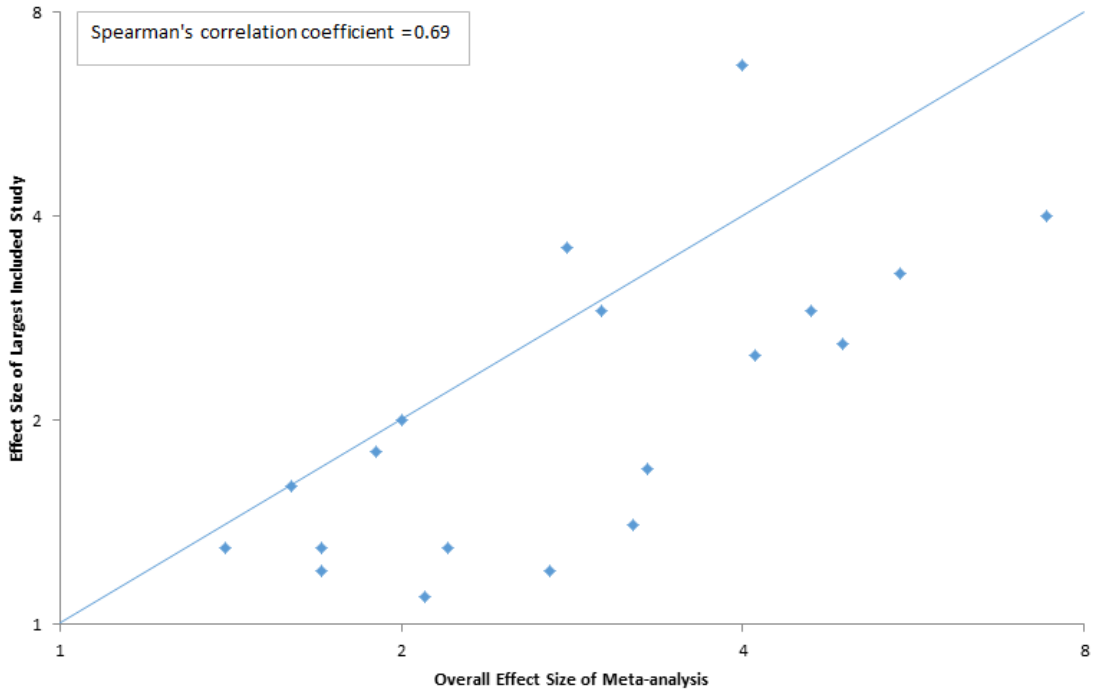

Figure 12 - Correlation between the effect sizes of the largest study and overall meta-analysis effect sizes

3.1.6.3 Assessment 3

Ratios between overall meta-analysis effect sizes and the effect sizes of the largest included studies in each meta-analysis were calculated when sufficient data were available (Table 5). As for Assessment 2, the effect size of the largest included study has been labelled as 'E' for 'expected' as we have assumed that the largest included study is the most precise study and is closest to the 'true' effect. The overall result of the meta-analysis has been labelled 'O' for 'observed' effect. An 'O/E ratio' of more than one indicates a larger effect size in the meta-analyses compared to its largest included study. This is a similar analysis to 'Assessment 2' and is intended to supplement this.

Study	Meta-analysis ES (O)*	Largest Study ES (E)**	O/E RATIO
Yu, 2012 [4]	3.0	2.9	1.0
Fazel, 2010 [2]	4.1	2.5	1.6
Fazel, 2009 [25]	1.7	1.3	1.3
Fazel, 2009 [25]	0.7	0.7	1.0
Fazel, 2009 [24]	7.4	4.0	1.9
Fazel, 2009 [24]	5.5	3.4	1.6
Fazel, 2009 [24]	4.9	2.6	1.9
Ttofi, 2012 [27]	1.4	1.3	1.2
Wilson, 2009 [28]	2.7	1.2	2.3
Murray, 2012 [29]	1.6	1.6	1.0
Stamms, 2006 [31]	4.0	6.7	0.6
Morgan, 2000 [32]	2.8	3.6	0.8
G-Gonzalez, 2006 [37]	4.6	2.9	1.6
Kanwar, 2013 [46]	3.3	1.7	1.9
Yoshimasu, 2008 [45]	2.1	1.1	1.9
Anglemyer, 2014 [50]	3.2	1.4	2.3
Milner, 2013[47]	1.7	1.2	1.4
Geulayov, 2012 [43]	1.9	1.8	1.1
Paloucci, 2000 [44]	2.2	1.3	1.7
Hoeve, 2012 [34]	2.0	2.0	1.0
Bell, 2009 [51]	3.3	0.2	16.5

Table 5 – Ratios between meta-analyses' overall effect size or 'observed' effect size ('O') and effect size of largest included study in meta-analysis or 'expected' ('E')

3.1.6.4 Assessment 4

A comparison was made between meta-analyses' overall effect size and the number of cases included in each meta-analysis when sufficient data were available (Figure 13). Concerning results would have placed large numbers of high effect sizes for meta-analyses with a low number of included cases. Results were not distributed in this fashion (Figure 13).

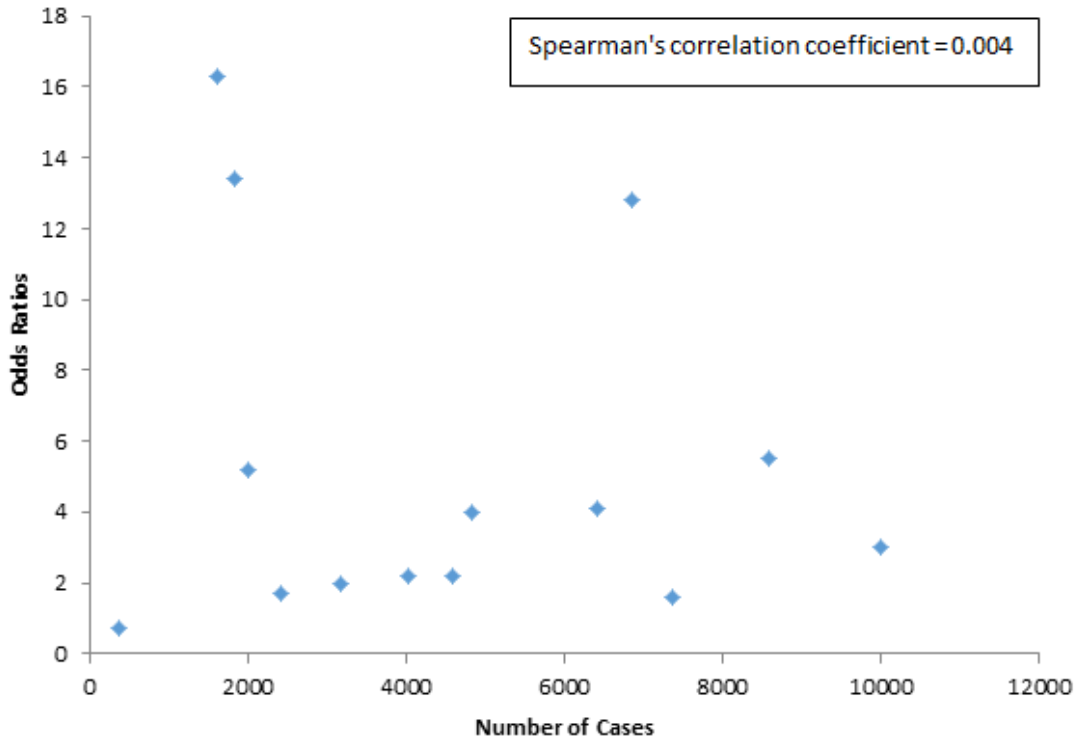

Figure 13 - Association between the Overall Effect Size and Number of Cases in Meta-analyses

3.1.6.5 Assessment 5

It was attempted to assess the relationship between study design and effect size. This assessment aimed to analyse if high quality designs of prospective studies had different effect sizes when examined alone, in comparison to other designs such as cross-sectional studies or retrospective studies. Data were extracted for pooled overall effect sizes of prospective studies alone and compared to overall meta-analysis' effect sizes. Two meta-analyses had sufficient data to directly compare results for prospective studies alone.[28, 29] One review reported a slightly lower overall effect size for prospective studies in comparison with the overall meta-analysis result.[28] However, when investigated in more detail it emerged that large discrepancies existed when prospective study results were compared to cross section studies (d = 0.31 and d = 0.88 respectively, or as ORs, OR = 1.8 and OR = 4.9 respectively). Conversely, larger effect sizes were found for prospective study designs when compared with

retrospective, cross-sectional study designs as well as with the overall meta-analysis pooled effect size in the second review.[29] These differences fell short of statistical significance. Differences in effect size did not reach statistical significance in a further review, which compared effect sizes between nested case-control studies, longitudinal, cross-sectional and case-control studies.[24] This will be discussed further in the Discussion Section.

3.2 Results for Violence Not Eligible for Data Synthesis

Reviews considered relevant to risk factors for violence but which were not eligible for inclusion in the main results section are discussed here. Examples of why reviews were considered ineligible were as follows: Reviews which did not use interpersonal violence as an outcome measure. Several reviews were found, which used outcome measures allied to interpersonal violence, such as aggression, anger and hostility.[63, 64] Other reviews provided relevant information on topics such as autism, learning disability and offending but did not have sufficient data to calculate effect sizes.[14, 15]

These meta-analyses and systematic reviews were grouped into different categories, as was done for the main results section. Risk categories were as follows: neuropsychiatric, environmental, biological and 'quasi-biological'.

3.2.1 Neuropsychiatric Risk Factors for Violence

It has been suggested that individuals with autism spectrum disorders may be more likely to offend and/or carry out aggressive acts.[15] King and Murphy argue in their systematic review that, due to variation in methodologies and focuses in studies examining autism spectrum disorder and offending, as well as poor quality of much research to date in the area, it is only possible to draw tentative conclusions about the impact of autism spectrum disorder on crime. In individuals with autism spectrum disorder and a co-morbid psychiatric diagnosis, it has been postulated that offending in this group may be interpreted as a function of their

comorbid diagnoses rather than their autism spectrum disorder.[15] King and Murphy concluded that individuals with autism spectrum disorder are not disproportionately over-represented in the criminal justice system.[15] This review argues that research examining the relationship between autism and offending is "in its infancy" and that further high-quality research is required in this area.[15]

Learning disability has been hypothesised to be both a risk factor for offending and a protective factor for offending.[14] A systematic review by Simpson and Hogg examined what the extent of offending amongst people with learning disability was when compared to the general population.[14] The authors argue that there is no convincing evidence that the prevalence of offending among people with learning disability is higher than the general population.[14] However, the pattern of offending in individuals with learning disability may differ when compared to the general population. The review found some evidence that sexual offending, criminal damage and burglary were more common in those with an intelligence level in the 'borderline' range when compared to the general population. Offending in the population with an IQ below 50 was found to be rare. Serious offences, such as murder appeared to be underrepresented in individuals with learning disability.[14] Concerns are raised by the authors of this review about methodological limitations and quality limitations in the studies it included. It advises caution in drawing any firm conclusions from the review.[14]

These systematic reviews on autism spectrum disorder and learning disability clearly illustrate why the having a diagnosis of either of these things cannot produce a straight-forward effect size regarding risk of violence.

Anger and hostility in individuals who suffered from post-traumatic stress disorder was assessed in a meta-analysis of 39 studies.[63] This review reported positive correlation between having suffered trauma and having increased levels of anger and hostility. It was noted that

the time between traumatic event suffered and participation in assessments of anger and hospitality was not reported in a majority of studies included in this review (22 out of 39 included studies).[63] A range of different scales were used to measure anger, hostility and post-traumatic stress disorder symptoms. Although of interest, this review was excluded from our data synthesis as it did not contain data on interpersonal violence.

3.2.2 Environmental Risk Factors for Violence

Exposure to violence in the forms of video games, television and film has been suggested as risk factors for aggression.[64, 65, 66] Ferguson *et al.* conducted a meta-analysis to assess if media violence was a public health risk.[65] This review incorporated video games, television and film in its definition of media. It raised concerns about methodological limitations of included studies, such as poor aggression measures. After adjustment, a weak effect size was found r = 0.08 (95% CI = 0.03-0.13).[65] This effect size is equivalent to an odds ratio of 1.3 (95% CI = 1.1-1.6). The authors conclude that this is not sufficient to claim a correlation link between exposure to media violence and subsequent aggression. A separate meta-analysis attempted to elucidate if media violence had an impact on criminal aggression.[64] This review wished to separate results for studies using aggression as an outcome measure from those using violence as an outcome measure. The authors concluded that no studies eligible for inclusion in this meta-analysis examined the relationship between media violence exposure and used simultaneously used serious criminal aggression or violent crime as their outcome measure.[64]

A more recent meta-analysis focused solely on exposure to violent video games and used aggressive behaviour, aggressive cognition, and aggressive affect, empathy and prosocial behaviour as its outcome measures.[66] Experimental study designs using "noise-blasts", "electric shocks" and "hot sauce to ostensible partner" or non-experimental studies using self-

reports, peer reports, parent or teacher reports were all examples of methods used by studies included in this review to define aggressive behaviour. The authors conclude that their evidence strongly suggests that exposure to violent video games is a "causal risk factor" for increased aggressive behaviour, aggressive cognition, and aggressive affect and for decreased empathy and prosocial behaviour.[66] It did not express similar concerns about methodological limitation of included studies as did the other reviews discussed in this section.[64, 65] This review was ultimately excluded from our data synthesis as it did not focus on interpersonal violence.

3.2.3 Biological and 'Quasi-Biological' Risk Factors for Violence

Two separate meta-analyses reported on genetic influences on antisocial behaviour.[67, 68] They both concluded that genetic influences make a significant contribution to antisocial behaviour. However, in a recent meta-analysis examining individual gene associations to violence and aggression, no single gene was found to have a significant impact.[69] An explanation for this may be that combinations of genes do increase the risk of violent behaviour, but specific combinations have not yet been elucidated. [70] The impact of genes in combination with environment has been found to be significant in a recent meta-analysis of studies examining the interaction between monoamine oxidase A (MAO-A) genotype and childhood maltreatment. MAO-A genotype was shown to moderate effects of historical maltreatment for male antisocial behaviour.[71]

In a meta-analysis of 144 studies, Duke *et al.* found that decreased central serotonin functioning (estimated by measuring serotonin metabolite 5-hydroxyindoleacetic acid or '5-HIAA') was linked to increased aggression.[72] In an earlier meta-analysis, Moore *et al.* reported a significant overall mean effect size linking lowered 5-HIAA to antisocial behaviour.[73] This review was excluded from the main results section due to difficulty of classification of 5-HIAA levels as a risk factor for violence. The more recent review by Duke

et al. focused only on different forms of aggression and not on interpersonal violence, therefore it was excluded from the main results section.

One meta-analysis examining the impact of heart rate and electrodermal activity on aggression, psychopathy and conduct problems concluded that low resting heart rate and high heart rate reactivity were associated with aggression and conduct problems.[74] This review also concluded that low resting electrodermal activity and low task electrodermal activity were associated with psychopathy/sociopathy and conducts problems. A separate meta-analysis published in the same year argued that heart rate appeared to be the "best-replicated biological correlate of antisocial behaviour in children and adolescents." [75] This review also found a significant negative relationship between resting heart rate and antisocial behaviour. In contrast to Lober, [74] Oriz [75] found that antisocial behaviour was negatively associated with heart rate under stressful conditions. Both reviews were ultimately excluded due to use of outcome measures that were not specifically interpersonal violence and the use of subgroup as the investigated population (children and adolescents rather than the general population).

Impairments in P300 event-related potential (or 'P3') and P3 latencies were investigated in a meta-analysis of 38 studies.[76] Individuals who had been violent were compared with 'controls'. Cases were classed as 'antisocial' or 'psychopathic'. Some of the cases had been diagnosed with antisocial personality disorder, psychopathy (by various different interviews), or had been violent or aggressive. Control cases varied from 'normal controls' to 'inmates' to 'alcoholics and drug abusers'. This review concluded that reduced P3 amplitudes and longer P3 latencies were significantly associated with antisocial behaviour. The reduction in P3 amplitudes was proposed to reflect a lack of recruitment in neural resources during information processing.[70] This review was excluded from the main results section due to difficulties in classification of P3 latencies as a risk factor for violence.

Increased testosterone levels have been implicated in aggressive behaviour. A meta-analysis was conducted by Book in 2001, which found a small effect size for the relationship between higher testosterone levels and aggression.[77] As interpersonal violence was not used as an outcome measure, this review was excluded from the main results section. This review was critiqued later by Archer *et al.* 2005.[78] This critique argued there were several inaccuracies and mistakes in the original review and the correct mean weighted correlation between testosterone and aggression was lower than reported in the initial meta-analysis.

Aggression was found to be more common in men than women in a meta-analysis of studies examining sex differences in aggression.[79] This review focused on different forms of aggression, including physical aggression, but did not directly look at interpersonal violence. For this reason, it was not eligible for inclusion in the main results section.

Maternal cigarette smoking has been assumed to be a risk factor for 'deviant' or criminal behaviour later in life in a review by Pratt.[80] A meta-analysis reported a small but statically significant overall mean effect size, which claimed to support this link. It has since been argued that smoking during in pregnancy is linked to other risk factors which predispose individuals to violence later in life, for example; parental antisocial behaviour, low socioeconomic status and exposure to parental substance abuse.[81] In light of this argument, it was decided to discuss this review in this section rather than to include it in the main results section.

There is a large body of literature on brain structure, function, and antisocial behaviour.[70] One meta-analysis was assessed for eligibility for inclusion in this review, which examined prefrontal structure and functional brain imaging in antisocial, violent and psychopathic individuals.[82] This review's methodology involved comparing antisocial, violent and psychopathic individuals to control individuals. It was not eligible for inclusion in the main

results section as the effect size it quoted was for the impact of being antisocial, violent or psychopathic on prefrontal structure and function rather than the reverse of this. There has been variation in results of neuroimaging studies examining the structure and function in psychopathy. Abnormalities have been consistently reported in the pre-fronto-temporo-limbic circuit.[83]

3.3 Results for Psychological Factors and Suicide

When the results for risk factors for violence were compared to risk factors for suicide, it was noted that no psychological risk factors for suicide were found. Or at least that is to say, no eligible reviews with effect sizes for psychological risk factors and suicide were available. Further investigation into psychological risk factors was undertaken in order to address this 'gap' in the results.

A recent review of the topic has suggested that the key psychological risk factors for suicide can be broadly classified into four groups: personality and individual differences, cognitive factors, social factors and negative life-events.[84] These categories are unlikely to be exhaustive. An additional relevant review on sexual orientation and suicide attempts was noted. It found a pooled life-time increased relative risk for suicide attempts of 2.5 (95% CI 1.9 – 3.3) for people who identify as gay, lesbian or bisexual.[13] A meta-analysis carried out in 2012 found evidence to support that both former and current smokers are at increased risk of suicide.[85]

Hopelessness, impulsivity, perfectionism, high levels of lifetime aggression and extremes in areas of neuroticism and extroversion are examples of personality and individual differences implicated as risk factors for suicidal behaviour.[86] Cognitive rigidity, rumination and poor problem solving skills are examples of cognitive risk factors for suicide. Social isolation,

exposure to suicidal behaviour in others, physical illnesses and traumatic life events have been implicated as social factors and negative life-events linked to suicide risk.[84]

An overview of key systematic reviews has been outlined below based on expert commentary on the psychology of suicidal behaviour [84] as well as targeted searches. Many of these relevant reviews fall slightly outside our initial inclusion criteria, namely as they predominantly focus on attempted suicide, deliberate self-harm and suicidal ideation rather than on completed suicide alone.

3.3.1 Personality and Individual Differences and Suicide Risk

A systematic review by Brezo *et al.* examined personality traits and suicidal behaviour. [87] A subsection of this review focused on 11 studies, which used completed suicide alone as their outcome measure. This review commented on the limited amount of studies on personality traits and suicide using completed suicide as an outcome measure, in contrast to use of outcome measures of self-harm or suicidal ideation. This 'gap' in the literature is also commented on by Hawton and van Heering's Lancet Seminar on suicide.[86]

Important personality factors implicated as risks for suicide completion were high levels of 'neuroticism', introversion and lack of openness to experience.[87] With respect to neuroticism, people who scored high in certain domains, namely self-consciousness, depression and anxiety appeared to be at increased risk of suicide completion. People who scored low on extraversion (i.e. were social 'introverts') and those who had low scores on being open to experience (defined as, interest in novelty, variety and experience for its own sake) appeared to be at higher risk of suicide.[87] High levels of impulsivity have been implicated in most, but not all studies as a risk factor for suicide [88] while hopelessness has been found to be a strong predictor of suicide.[86]

A systematic review by Gvion and Apter commented on the difficulty in defining and measuring aggression and impulsivity.[88] Furthermore, both aggression and impulsivity proved difficult to separate completely due to their overlap. The authors conclude that aggression and impulsivity are associated with suicidal behaviour, but the exact nature of this relationship remains unclear. Gvion and Apter suggest that further research could focus on clarifying and refining both concepts of aggression and impulsivity. This may help address difficulties such as the large amount of heterogeneity between research methods in studies examining the links between impulsivity, aggression and suicidal behaviour.[88]

Perfectionism is another personality trait implicated in suicide risk. A systematic review by O'Connor concluded that there is substantial evidence that perfectionism is correlated with suicidality.[89] Measures of suicidality used in eligible studies were diverse. Dimensions of measurement of perfectionism included; concerns over mistakes, high parental expectation and high personal standards. There was heterogeneity in perfection measure scales used between included studies.

3.3.2 Cognitive Factors and Suicide Risk

Deficits in problem-solving skills have been implicated as a cognitive risk factor for suicide. A systematic review by Speckens and Hawton concluded that it was difficult to establish if deficiencies in problem solving skills lead to depression and then to suicidal behaviour, or if depression is the main risk factor for deterioration in problem-solving skills. [90]

In a systematic review of rumination and suicidality, the authors commented on heterogeneity in measures of suicidality and rumination between eligible studies. Rumination appeared to be related to suicidality in the vast majority of studies included in this systematic review. [91]

Lacking a sense of belonging has been cited as a cognitive risk factor for suicide. [92] A recent systematic review on this topic concluded that a low sense of belonging had a "weak

association" with suicidality.[92] The authors commented that most included studies were in nonclinical populations, and the association between a sense of belonging and suicidality could have been accounted for by confounding factors such as co-morbid depression or social isolation. This review included measures of suicidality relating to self-harm and suicidal ideation.

A separate systematic review examining people's sense of connectedness and suicidality found an association between a limited sense of connectedness and suicidal behaviour. This review was limited to people over 65 years of age. [93]

3.3.3 Social Factors, Negative Life-Events and Suicide Risk

There is some evidence to suggest that being the victim of bullying or abuse from an intimate partner increases risk of suicide.[94, 95] In a large review on bullying it was noted that many studies included failed to control for other well-established suicide risk factors, such as depression. There were large variations in methodologies used in eligible studies. Some studies used self-report, peer report or questionnaires for bullying assessment and assessment of suicidal behaviour (suicidal thoughts, self-harm and suicide attempts). This review did not include information on completed suicide. The authors concluded that it was not possible to make a causal association between bullying victimization and suicidality as all eligible studies in this review were cross-sectional in design.[94]

Eligible studies examining intimate partner abuse victimization measured suicidal thoughts and behaviours, this review did not focus exclusively on completed suicides. Measures of intimate partner abuse varied between studies, with some studies focusing on physical abuse only, while others included broader forms of abuse. Time periods after abuse also varied between studies. Recent exposure to intimate partner abuse was used in some studies, while others looked at life-time exposure or at people currently experiencing abuse. Suicidality

measures varied between eligible studies, examples of measures included; Beck Scale for Suicidal Ideation, Self-Harm Inventory, self-reports, medical records of self-harm and suicide attempts. A systematic review, which included 37 studies examining the link between intimate partner abuse and suicidality reported a correlation between intimate partner abuse and suicidality in all but one of their included studies.[95]

Exposure to media reporting and the internet may be important in suicide risk. A recent systematic review examining media reporting of suicides and suicide rates in the general population concluded that most studies supported the idea that there is a link between media reporting of suicidal behaviours and suicidality.[96] Most eligible studies reported on short-term effects (less than 4 weeks) of media reporting and suicidality in the general population. Many studies included looked at overall suicide rates and examined if they rose following reporting of high-profile suicides. A review on exposure to the internet was less conclusive, asserting that internet use may exert both positive and negative effects on young people at risk of self-harm or suicide. [97]

Adverse life events appear to play an important role in completed suicides. In a review of psychological autopsy studies, the authors concluded that nearly all suicide cases had experienced at least one adverse life event within one year of death.[98] The adverse life event(s) were often concentrated around the last few months of life. The greatest risk of suicide associated with adverse life events were connected to interpersonal conflict.

Physical illness has been implicated in suicide risk. A review examining people suffering from chronic pain and suicidality estimated that, relative to controls, risk of death by suicide in people with chronic pain is "at least doubled".[99] Specific important factors related to chronic pain were identified such as; type, intensity, duration, co-morbid insomnia, feelings

of helplessness and hopelessness towards pain. As is the case with many psychological risk factors for suicide, it is difficult to be certain if the physical illness itself is responsible for increased suicide risk, or if it is other issues related to physical illness, such as depression, that increase the risk.

3.3.4 Discussion on Results for Psychological Risk Factors for Suicide

The apparent lack of eligible meta-analyses examining psychological risk factors for suicide may be due to the challenges of quantifying effect sizes for psychological factors in people who have completed suicide. It is challenging to establish the impact of specific psychological factors when complex interactions between other important factors, such as mental illness, are taken into account. Recurrent problems encountered by reviews investigating psychological factors and suicide were a lack of uniform measurements for psychological factors as well as limited control for confounding factors in empirical studies. Another difficulty is the lack of certainty around the temporality of risk factors. For example, if poor problem solving skills are a risk factor for suicide alone, or if they are simply a result other issues like depression, which in turn causes an increase in suicide risk. Reviews using outcome measures of self-harm or attempted suicide may be in a better position to evaluate psychological factors in individuals who can be assessed following attempted suicide and self-harm. It is possible that the focus of this umbrella review on completed suicide limited assessment of psychological risk factors for suicide.

3.3.5 Conclusion on Results for Psychological Risk Factors for Suicide

The precise study of psychological risk factors and their quantifiable impact on completed suicide has proven challenging. With no eligible meta-analyses found on this topic, it may be necessary to infer from other reviews, which used outcome measures allied to completed

suicide (namely suicidal behaviour), that important psychological risk factors for completed suicide can be grouped under the following categories: personality and individual differences, cognitive factors, social factors and negative life-events.

Chapter 4 – Discussion

4.1 Overview

This section revisits the main aims. It discusses these in the context of challenges faced when analysing violence and suicide. The main findings are recapitulated and quality analyses of included reviews are interpreted. Strengths and limitations are reflected upon. The implications of the review's findings are discussed and areas for further research are considered.

4.2 Main Aims

This umbrella review aimed to systematically examine risk factors for violence and suicide in the general population across multiple risk categories, to assess to what extent risk factors for violence and suicide overlapped and to determine the impact of different risk factors at a population level.

4.3 Challenges in Analysing Violence and Suicide

As violence and suicide are complex outcomes, inevitably some challenges arose when trying to quantify their risk factors. Outcome measures used for violence were heterogeneous. Reviews focusing on neuropsychiatric risk factors generally used violent crime as their outcome measure.[24] Some differences were seen in reviews examining younger populations, which often used delinquency,[26] defined as any behaviour prohibited by law, or more general forms of antisocial behaviour.[28] Although effect sizes were compared directly in forest plots, the exact nature of the violence differed somewhat between risk factors. To address this, at least to some extent, risk factors were grouped separately for broadly different forms of violence where possible. For example, separate analyses were carried out for violence specific to intimate partner relationships, sexual violence and homicide.

Further challenges arose for reviews examining factors with more complex or variable impacts, for example, learning disability at profound severity was deemed to be a protective factor for violence, but at milder severity appeared to be a risk factor for violence. [14] It was also not possible to deduce single overall effect size for autism and violence.[15]

Certain risk factors for violence proved challenging to group into clear risk categories. P300 potentials, electrodermal activity or levels of serotonin and testosterone are some examples.[75, 76,78] It is currently unclear how these factors could be aligned with practical clinical risk assessment. Measurement of these factors is not routinely done when carrying out risk assessments and even in the event of such tests being easily available, their full significance is as yet uncertain. Biological risk factors for violence and suicide is an ongoing area of research.[69, 100]

Completed suicide was not open to the same variability as violence. However, the exclusive use of completed suicide as an outcome measure did not lend itself well to the examination of psychological risk factors for suicide. The paucity of eligible reviews examining psychological risk factors for completed suicide may be due to the difficulty of measuring psychological factors in retrospect in people who have completed suicide.

Reviews examining psychological factors and suicide tended to include suicide attempts or suicidal behaviour in their study eligibility criteria. To avoid omission of this risk category, a slight broadening of inclusion criteria from completed suicide only to suicidal behaviour, attempted suicide and self-harm was necessary. Due to the deviation from original inclusion criteria, a separate results section was required to adequately address the area of psychological risk factors and suicide.

4.4 Recapitulation Main Findings - Strengths of Associations and Overlap between Violence and Suicide

Neuropsychiatric risk factors had the strongest association between violence and suicide. Particularly strong associations were found between neuropsychiatric risk factors and suicide. Other important risk areas for violence and suicide were environmental, psychological, parental and historic risk categories.

Clear overlap was found between neuropsychiatric risk factors for violence and suicide. Schizophrenia, bipolar disorder, substance abuse, personality disorder and hyperkinetic disorder were found to be risk factors for both violence and suicide. It was noted that epilepsy appeared to increase the risk of suicide but decrease the risk of violence.[25, 51]

Four neuropsychiatric risk factors were found (two for violence and two for suicide), which did not overlap for the two outcomes. Traumatic brain injury and non-schizophrenia psychoses were found to be risk factors for violence. No eligible reviews were found, which examined these two factors, for suicide risk. It cannot be assumed that no evidence existed for these factors in relation to suicide risk, merely it was noted that no relevant reviews were identified. In fact, there is evidence that traumatic brain injury is a risk factor for suicide in a population study.[101] Schizophrenia was reported as a risk factor for suicide; differentiation was not made between schizophrenia and psychoses due to other causes, as it was in a review for violence.[3, 24]

Anxiety disorders were found to be a risk factor for suicide.[46] No similar eligible reviews were found for violence. Research evidence exists, which was ineligible for inclusion in this review, which supports a link between one type of anxiety disorder (post-traumatic stress disorder) and increased risk of aggression.[63] Of note, depression was found to be a risk factor for intimate partner violence but not for general interpersonal violence.[35] However, a link

between depression and violent crime has been found but this research was not eligible for this review due to its methodology falling outside the inclusion criteria.[102]

These are all clear examples of how relevant risk factors for both violence and suicide may have been missed by this review, due to the inclusion criteria limiting methodology to systematic review, meta-analyses and meta-reviews.

Overlap between environmental, historic and parental risk categories was less distinct than the overlap between neuropsychiatric risk factors. Similar themes of past behaviour being a predictor of future behaviour were seen. Youth antisocial behaviour was found to be a risk factor for violent crime in later life, as previous suicide attempts and self-harm were found to be risk factors for completed suicide.[30, 45] Exposure to violence and suicidal behaviour also overlapped as risk factors for subsequent violence and suicide.[28, 35, 40]

A common theme of previous abuse and trauma runs between risk factors for violence and suicide. Past sexual abuse was found to be a risk factor for suicide, while 'family problems' (an array of problems, including physical and sexual abuse) were found to be risk factors for sexual violence as well as for more general forms of violence.[5, 41, 44]

Challenges arose when analysing psychological risk factors for violence and suicide. For example, there is a lack of uniform measurements for psychological risk factors. Therefor it is difficult to accurately compare and contrast psychological risk factors for violence and suicide.

Psychological factors of low empathy, poor executive function and poor moral judgement were risk factors for violence.[31, 31, 32,] It is difficult to envisage how these factors could directly overlap with suicide risk. High levels of impulsivity and aggression have been reviewed as risk factors for suicide.[88] Intuitively it could be proposed that these factors may

overlap with risk factors for violence. Due to the challenges of measuring psychological factors and overlap between the two psychological factors of impulsivity and aggression, uncertainty remains in this area. Examples of other psychological risk factors that are difficult to envisage an overlap with violence are perfectionism, introversion, rumination, and social isolation. Intuitively it seems that some of these factors may even be protective for violence rather than risks for violence, such as social isolation.

The significance of overlap found between risk factors is uncertain. It could be argued due to clearly defined overlap between neuropsychiatric risk factors for violence and suicide that a subgroup of individuals who are violent may also be at increased risk of suicide. By implication, the same could be argued for a subgroup of people who attempt suicide having vulnerability factors that are also risks for violence.

Some common mechanisms may exist between neuropsychiatric risk factors and the outcomes of violence and suicide. It is acknowledged that no data were collected on the temporality of violence and suicide and the symptoms of neuropsychiatric risk factors. For example, an individual committing a violent act in response to a persecutory delusion appears to be highly unlikely to be due to the same mechanism as an individual with a diagnosis of schizophrenia ending their life when in remission. However, elucidation of the mechanisms of how risk factors lead to the outcomes of violence or suicide was beyond the scope of this review.

4.5 Intimate Partner Violence as an Outcome

Violence perpetrated by one partner in an intimate relationship to another was used as a specific outcome measure for violence in five eligible reviews.[35, 35, 36, 37, 39] Many risk factors for intimate partner violence overlapped with risk factors for more generalized interpersonal violence, such as a history of violence perpetration, substance abuse and exposure to

violence. Attitudes condoning violence was a risk factor for intimate partner violence. This overlaps somewhat with attitudes tolerant of sexual offending being a risk factor for sexual violence and antisocial attitudes in parents and peers being a risk factor for interpersonal violence.[35, 38, 42] The risk factor of depression overlaps between suicide and intimate partner violence. It is challenging to contrast certain risk factors with violence in general as some risk factors appear to be specific to intimate partner relationships, such as high levels of marital discord and low levels of marital satisfaction or high levels of jealousy.

4.6 Sexual Violence and Homicide as Outcomes

Risk factors for sexual violence and homicide largely overlapped with risk factors for intimate partner violence and more general forms of violence. Limited eligible data were available for homicide as it is a relatively rare outcome. The only specific risk factor for sexual violence appeared to be 'sexual problems', which incorporated items such as the use of sexual activity as a coping mechanism as well as paraphilia.[42] This risk factor was not assessed for suicide or other forms of interpersonal violence in eligible reviews.

4.7 Results Stratified by Gender

Effect sizes for females were higher than for males for every neuropsychiatric risk factor it was possible to stratify by gender for violence, namely; personality disorder, traumatic brain injury, bipolar disorder, schizophrenia and other psychosis. This is consistent with findings of previous research.[103] Substance abuse and non-concordance with medication has been seen more commonly in males with mental illnesses when compared to females with mental illnesses.[104] It has been proposed that violence in females, due to causes other than substance abuse, (e.g. psychotic illness) may be over-represented due to the lower prevalence of substance abuse in women when compared to men.[103] Previous research has also found that, although females with severe mental illness have a higher relative risk of violence than males, this has a low overall impact at a population level.[103]

With respect to parental and historic risk factors for violence, neither the risk factor of parental incarceration nor exposure to violence reached a statistically significant difference between males and females.[28, 29]

Men had a stronger association for violence with the risk factors of marital discord and low levels of marital satisfaction than women. This could be explained by the use of violence by men being more likely to have a high impact hence men in relationships with high levels of conflict are more predisposed to violence than women.[36]

The effect size for suicide risk was larger for women than for men, for both depression and substance abuse.[23] However, men had a higher effect size for personality disorder as a risk factor for suicide than women.[23] Further comparison between neuropsychiatric risk factors for males, females and suicide was not possible due to the necessary data being unavailable in many included reviews. For the comparisons between risk factors in the environmental and historic domains for suicide when effect sizes were stratified by gender, no large discrepancies found between the two. [23, 45]

In summary, when comparison was possible between genders, women tended to have higher effect sizes than men for neuropsychiatric risk factors for violence and suicide, with the exception of personality disorder in men for suicide. There did not appear to be any large differences between males and females for historic, parental and environmental risk factors for violence and suicide.

4.8 Population Attributable Fractions

Population attributable fractions (PAFs) can be interpreted as the percentage by which violence or suicide could be reduced if the risk factor under examination was removed from the population, assuming a direct causal link between the risk factor and outcome.[21] For

example, if substance misuse was removed, there would be in the region of 15% fewer cases of violence and 11% fewer completed suicides (Table 3, Table 4).

PAF results illustrate that an effect size for a risk factor is not a complete representation. PAFs are sensitive to prevalence and demonstrate how a risk factor with a high effect size but low prevalence could have a less significant impact at a population level than a risk factor with a lower effect size but higher prevalence. The neuropsychiatric risk factor for violence with the highest effect size (substance abuse) also had the highest PAF. However, the second highest PAF in this category was a combined effect for any personality disorder. In terms of the effect size alone, personality disorder was rated only fifth largest, behind substance abuse, schizophrenia, bipolar disorder and non-schizophrenia psychoses. For suicide, depression had a lower effect size than bipolar disorder, but due to the higher prevalence of depression, the PAF for depression was higher than for bipolar disorder (Table 4). These are examples of how risk factors with a relatively low effect size but high prevalence can have more impact than their effect size alone might suggest.

It is acknowledged that the use of PAFs have limitations. PAF results assume a direct causal link between the risk factor and the outcome. Due to the multifaceted nature of both violence and suicide, it is likely that multiple different components impact upon them, so it is not completely accurate to utilize PAFs. In addition to this, some calculations had to be omitted due to lack of available high quality data on prevalence. Examples of uncertain prevalence were found for factors, such as attitudes to various types of offending.

4.9 Quality Assessments of Included Reviews

4.9.1 The ‘AMSTAR’ Tool

The AMSTAR (assessing the methodological quality of systematic reviews) tool was used as an objective quality assessment of reviews included in the main results section. This tool is

not without disadvantages. It has been argued that does not effectively quantitatively appraise quality. [105]

The AMSTAR tool weights all eleven items equally, giving a score '1' for 'yes' and '0' for 'no', in relation to whether an item is present or absent (Table 2). Each item may not be of equal importance. For example, equal weighting is given to the presence or absence of a thorough literature search and a declaration of conflicts of interest. Furthermore, the question styles differ throughout the tool. Some questions have a clear answer, for example, the tool asks for a 'yes or no' answer to the question "Was 'grey' (unpublished) literature considered?" Other questions within to tool are open to the assessors' own judgement, for example, "Were methods used to combine the findings of studies appropriate?" Variation between users of this tool seems inevitable, however there is some evidence to support that inter-rater reliability as well as the overall validity of this tool is good.[16, 106]

AMSTAR scores were calculated for all reviews included in the main results section. In presentation of results, no differentiation was made between low, high or medium scoring reviews. No reviews were excluded on the basis of having a low AMSTAR score and theoretically, even reviews with the lowest possible AMSTAR score would have been included and their results given equal consideration to other more highly-rated work. However, the vast majority (33/34 or 97.1%) of reviews included in the main results section had at least a medium AMSTAR score. Issues around quality of included reviews is discussed further in the 'Strengths and Limitations' section below.

4.9.2 Effect Size

This review considered the possibility that overall meta-analysis effect sizes were at risk of overestimating the true effect size. As the results of smaller studies are at higher risk of

producing less accurate effect sizes, the largest study included in each meta-analysis was assumed to be the most accurate and the closest to the true effect size. [21, 107]

In approximately 80% of tested reviews, the largest included study showed smaller effect sizes than the overall effect size from the meta-analysis. This illustrates that overall effect size may be exaggerated and should be interpreted with caution. It is possible that smaller studies were more inaccurate and overestimated their effect sizes.[108] It could also be argued that this finding could be explained by publication bias. Publication bias may have prevented the publication of small studies without significant results, but allowed for publication of smaller studies with significant positive results, hence inflating the overall meta-analysis effect size.[107]

When the number of cases included in each meta-analysis was compared with the overall meta-analysis effect size, no correlation was found. A result questioning the quality of the review would have been if most of the high effect sizes for meta-analyses were correlated with small sample sizes. The absence of a correlation in this case could be explained by effect sizes differing in magnitude between risk categories.

4.9.3 The Impact of Study Design

The majority of eligible meta-analyses combined results from a mixture of cross-sectional, prospective and retrospective study designs, while a small number of reviews exclusively used prospective studies.[5, 27] The potential impact of study design on effect size was investigated. It was postulated that high quality prospective study designs would produce more accurate effect sizes than their retrospective and cross-sectional design counterparts as they are not as vulnerable to recall bias and are better placed to account for confounding variables.[109]

Ideally comparisons would have been made between all pooled effect sizes from different study designs as well as comparison between study design effect size and the overall pooled effect size of each meta-analysis. Three reviews allowed direct analysis between effect sizes of different study designs.[24, 28, 29]

One of these reviews showed a discrepancy of statistical significance when effect sizes of cross-sectional and prospective study designs were compared.[28] The effect size from prospective studies alone was smaller than the overall meta-analysis effect size in the same review.

Larger effect sizes were found for prospective study designs when compared with retrospective, cross-sectional study designs as well as with the overall meta-analysis pooled effect size in a separate review.[29] These differences fell short of statistical significance. Differences in effect size did not reach statistical significance in a further review, which compared effect sizes between nested case-control studies, longitudinal, cross-sectional and case-control studies.[24]

Although only one review found a statistically significant difference when comparing study designs, this must be considered very seriously. It is possible that many more included reviews would have shown discrepancies between different study designs if analysis on this had been conducted. It must therefore be inferred that study designs are important and can impact upon results. This review gave equal weighting to reviews exclusively using prospective studies and reviews containing mixed empirical study methodologies. Justification for this can be made as, due to the scarcity of such work, if only reviews using exclusively prospective studies were included; this would have severely limited the range of this review.

4.10 Strengths and Limitations

To the best of my knowledge, this is the first review to provide a broad combined overview of risk factors for both violence and suicide across multiple risk categories. This review has assimilated data from a large volume of research examining a broad range of different risk factors from many different countries. A significant volume of research that was deemed relevant but not compatible with the main results section was included for discussion. This flexibility allowed maximisation of range and depth of this review. This review took time to carefully consider and critically appraise included reviews across many different areas and did not simply take results of published work at face value. Quality assessments and further analysis of included reviews was undertaken.

The choice to use umbrella review methodology had both advantages and disadvantages. A wide comprehensive overview of current evidence was gained by conducting an umbrella review. A transparent and reproducible systematic search strategy was used and prospectively registered on an international database of reviews.[110] This strategy reduced error and bias and increased transparency and accountability.

It must be acknowledged that this review is somewhat dependant on the quality of reviews it has included. To address this, quality of all included reviews for primary outcomes was objectively assessed with the AMSTAR tool (Table 2). All but one included review had an AMSTAR quality rating of either medium or high quality. Nevertheless, it still should be considered that the AMSTAR quality rating largely focuses on the general methodological quality of a review and does not necessarily elucidate the quality the primary studies included in each review. It is theoretically possible therefore that a review could have a high quality rating AMSTAR score despite having included data from low quality primary studies. While AMSTAR scores provided an objective rating of review quality, it was not possible to get a clear objective overview of the quality of primary studies included in every review.

The most recent review for each risk factor was selected. This is to say, for example, if more than one review was found on a given risk factor, only the most recent review was included. However, it fails to take quality into account. For example, if two separate reviews were found on the same risk factor, even if the older review was of higher quality, it would have automatically been excluded due to its date of publication. This must be acknowledged as a theoretical limitation. In practice, only five potentially eligible reviews were excluded due a more recently published review being found on the same risk factor.[111, 112, 113, 114, 115] These reviews were excluded prior to undergoing quality assessment. A possible further investigation would be to carry out AMSTAR scores for the older excluded reviews to assess if any theoretically higher quality reviews were excluded for newer but inferior quality reviews. A positive aspect of this method of selection is that it is unbiased.

If this review was to assess itself with the same AMSTAR tool used for quality assessment in included reviews, it would be noted that review selection from the search protocol and data extractions were not done by two independent reviewers. However, measures have been taken to address this. Frequent discussion was had between my supervisor and I, regarding appropriate reviews for inclusion and possible missed reviews. Consultation and discussion was also had with senior researchers working in independent research groups to discuss the possibility of missing reviews. Extracted data were cross-checked by a post-doctoral student.

In order to create a broad overview of the risk factors for violence and suicide, only systematic reviews, meta-analyses and meta-reviews were included. This method had the advantage of being a relatively efficient way of gathering results from multiple different studies. Broadening the inclusion criteria to include all empirical studies may have been impractical due to constraints in time and ‘manpower’. This decision also had its limitations as it required reviews to have been undertaken for all relevant risk factors. It has been postulated that other risk factors exist for both violence and suicide, which were missed in

this review due to the lack of review articles on certain risk factors. A possible example of this can be illustrated by the case of traumatic brain injury as a risk factor for violence and suicide. An appropriate review was found for violence and traumatic brain injury. No such review could be found for suicide. On further investigation it emerged that research had been undertaken, which examined traumatic brain injury as a risk factor for suicide.[101] This opens the possibility that many more important risk factors for violence and suicide exist, but were not detected by this review due to the decision to limit the inclusion criteria to reviews only.

It is also possible that risk factors were missed due to publication bias. Grey literature was considered, however, the final result was that only published reviews were included. Unpublished reviews were not intentionally excluded however there is the possibility of the existence of completed reviews that were not detected as they were not available on online databases.

Violence and suicide are undoubtedly complex outcomes. Risk factors were discussed in categories but effect sizes for risk factors were quoted in isolation. It could be argued that this does not accord with the real world, where many different risk factors coexist in the same individual. For example, someone may be abusing substances, have a diagnosis of one or more mental disorders in addition to this, as well as come from a socioeconomically disadvantaged background. Assessing if risk factors interact was beyond the scope of this review, but is likely to be closer to what is found in clinical practice.

4.11 Potential Implications for Current Risk Assessment Tools

In risk assessment for violence and suicide, it appears that neuropsychiatric factors are the most important. This implies that neuropsychiatric risk factors should be prominent and appropriately weighted in any clinical risk assessment and should not be overlooked by a focus solely on environmental, historic, parental and psychological factors. Current risk

assessment and management tools for violence and suicide were examined to assess how the risk factors used by these tools relate to the findings of this review.

Commonly used tools to aid prediction and management of violence include the Historical, Clinical, Risk Management-20 (HCR-20), the Violence Risk Appraisal Guide (VRAG), The Spouse Assault Risk Assessment (SARA) and Structured Assessment of Violence in Youth (SAVRY).[116] These tools often require training prior to use and fees may be charged for tool user manuals and full versions of assessment tools.

The HCR-20 is classified as a structured clinical judgement tool. It includes past and current major mental illness in its assessment. It gives equal weighting to neuropsychiatric risk factors ("substance use problems", "major mental illness" and "personality disorder") as it does to socioeconomic factors such as "employment problems" and "relationship instability". Traumatic brain injury is a risk factor for violence based on the evidence found by this review. This factor is absent from the HRC-20. Guidance for using this tool acknowledges that its content is not exhaustive. The tool provides a formulation of risk to aid risk management rather than producing an absolute score to predict violence.

The VRAG does not include psychosis from causes other than schizophrenia. This review found evidence for non-schizophrenia psychoses being a risk factor for violence. As seen in the HCR-20, the VRAG omits the risk factor of traumatic brain injury. Of note, the VRAG assigns a negative score to meeting diagnostic criteria for schizophrenia, suggesting that this is a protective factor against violent recidivism.

SARA is used to predict spousal assault, while SAVRY is used to predict violent offending in adolescents. SARA focuses on intimate partner violence. It includes "substance abuse/dependence", "psychotic or manic symptoms" and "personality disorder" and considers these risk factors equally alongside "relationship" and "employment problems", a history of

violence and criminal activity, a specific history of intimate partner violence and severity of the most recent spousal assault. SAVRY examines risk factors from three different domains (historical, social/contextual and individual/clinical).

There is no specific suicide risk assessment tool recommended for use in the UK. The Royal College of Psychiatrists advised against use of locally developed risk assessment tools for suicide, which were not evidence based.[117] An example of a commonly used risk assessment tool for suicide is the SAD PERSONS scale.[118] It includes depression and alcohol abuse as neuropsychiatric risk factors for further suicide attempts. As for the VRAG violence risk assessment tool, the SAD PERSONS scale does not include assessment for use of substances apart from alcohol. Of note, the SAD PERSONS scale omits many neuropsychiatric risk factors that this review found evidence for, such as bipolar disorder, personality disorders and schizophrenia.

At the same time, it should be acknowledged that risk assessment tools can confer benefits in ways beyond risk prediction. They can aid risk management and highlight treatable risk factors.[116] They can also help structure risk assessments.

4.12 Overall Implications

The potential implications for current commonly used risk assessment tools and more general clinical risk assessment for violence and suicide are twofold. Firstly, all neuropsychiatric risk factors found to be risk factors for violence and suicide should be considered for inclusion in risk assessment. Secondly, I would suggest that in light of the findings of this review on strength of associations between neuropsychiatric risk factors being considerably stronger between violence and suicide than factors in other risk categories, neuropsychiatric factors are given more weight than factors from other risk categories. For example, with respect to the SAD PERSONS scale, the same weighting is given to the risk factors of depression and

being unmarried for suicide (1 point given for the presence of either risk factor). This review found a relative risk for depression of 13.4 (95% CI of 8.1 - 22.4) for suicide compared to a relative risk of 2.1 (95% CI 1.5 – 3.0) for being unmarried.

Due to the clearly defined overlap between neuropsychiatric risk factors for violence and suicide found by this review, clinical risk assessment should be mindful of the possibility of a subgroup of violent patients being at increased risk of suicide, and vice a versa.

Regarding population impact, the results of this review imply that targeting neuropsychiatric factors in interventions to reduce violence and suicide is of upmost importance. Any policy measure could be assisted by a comparison of PAFs between different risk categories. However, accurate PAF calculations were only possible for neuropsychiatric risk factors due to the uncertainty of the prevalence of risk factors in other risk categories.

In clinical practice, it is acknowledged that many individuals have multiple interacting risk factors rather than having only, for example, a personality disorder or substance abuse in isolation. Further research using similar methodology to this review could examine the impact of having multiple different risk factors in various combinations. It could assess how the presence of multiple different risk factors alters risk for violence and suicide.

Current literature has commented on the lack of high quality primary studies in some areas, for example autism spectrum disorders, learning disability and personality traits.[14, 15, 87] Further high quality primary studies into these areas are required. This review also found that biological risk factors for violence and suicide is still a developing area of research. An updated umbrella review of risk factors for violence and suicide could be conducted after a three-to-five year period to re-evaluate new evidence.

4.13 Conclusions

Neuropsychiatric risk factors for violence and suicide are important, perhaps more important than risk factors in other domains. This should be taken into account during clinical risk assessment and when using risk assessment tools.

The findings of this review should not be misinterpreted as suggesting that most individuals who suffer from mental illness are violent. Mental illness was only found to account for a small proportion of violence at a population level and appeared to have a more significant impact on suicide than on violence.

Overlap between neuropsychiatric risk factors for violence and suicide highlights the possibility of a subgroup of violent patients who are at increased risk of suicide and vice a versa. It is uncertain if common mechanisms exist between risk factors and the outcomes of violence and suicide. In-depth investigation of mechanisms and outcomes was beyond the scope of this review.

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Appendix A – Formulae used in Methods

1) Converting Cohen's d to Odds Ratio:

$$\textbf{Cohen's d} = \textbf{Log OddsRatio}(\sqrt{3}/\prod)$$

$$\textbf{Or, OR} = e^{\prod d/\sqrt{3}}$$

2) Converting correlation coefficient ('r') to Odds Ratio:

First r was converted to Cohen's d as follows:

$$\textbf{Cohen's d} = 2r / \sqrt{(1-r^2)}$$

The Cohen's d value was then used to calculate Odds Ratio from formula:

$$\textbf{Cohen's d} = \textbf{LogOddsRatio}(\sqrt{3}/\prod)$$

$$\textbf{Or, OR} = e^{\prod d/\sqrt{3}}$$

3) Converting Odds Ratio to Relative Risk:

$$RR = OR/(1-P_0+(P_0 \times OR)$$

Where P_0 = baseline risk or prevalence

4) Population attributable fraction:

$$PAF = P_0 (RR-1)/1+ P_0 (RR-1)$$

Where P_0 is the baseline risk

Appendix B – Neuropsychiatric Risk Factors for Violence

Cells left blank if data not published in original review. Abbreviations: k = Total number of studies analysed; N = Total number of cases; CI = Confidence Intervals; AMSTAR = Assessing the Methodological Quality of Systematic Reviews Scoring System

Author & Year	Risk Factor	Outcome Measure(s)	k	N	Original Effect Size	95% CI	Effect Size as OR	95% CI	AMSTAR Score
Yu, 2012	**Personality Disorder**	Violent crime, violent behaviour and antisocial behaviour							9
	All personality disorders		14	10,007	OR =3.0	2.6-3.5	3.0	2.6-3.5	
	Antisocial personality disorder				OR = 12.8	9.7-20.7	12.8	9.7-20.7	
Fazel, 2010	**Bipolar Disorder**	Violent crime e.g. homicide, assault, robbery, arson & sexual offences	9	6,383	OR = 4.1	2.9-5.8	4.1	2.9-5.8	8
Fazel, 2009	**Multiple**	Interpersonal violence &/or violent criminality							10
	Schizophrenia		13	8,578	OR = 5.5	4.1-7.5	5.5	4.1-7.5	
	Nonschizophrenia psychoses		7	99,668	OR = 4.9	3.6-6.6	4.9	3.6-6.6	
	Substance misuse		13		OR = 7.43	4.33-12.73	7.4	4.3-12.7	
Fazel, 2009	**Multiple**	Violence, violent crime or aggression	9	2,789					9
	Epilepsy		3	369	OR = 0.67	0.46-0.96	0.7	0.5-1.0	
	Traumatic brain injury		6	2,420	OR = 1.66	1.12-2.31	1.7	1.1-2.3	
Pratt, 2002	**Hyperkinetic disorder**	Crime & Delinquency e.g. violent crime, property crime and sexual assault	20	6261	r = 0.155	0.135-0.175	1.8	1.6-1.9	9

Appendix C – Historic Risk Factors for Violence

Cells left blank if data not published in original review. Abbreviations: k = Total number of studies analysed; N = Total number of cases; CI = Confidence Intervals; AMSTAR = Assessing the Methodological Quality of Systematic Reviews Scoring System

Author & Year	Risk Factor	Outcome Measure(s)	k	N	Original Effect Size	95% CI	Effect Size as OR	95% CI	AMSTAR Score
Ttofi, 2011	**Victimization of Bullying (self- and peer-rated)**	Aggression or violence towards others	12		OR = 1.4	1.2-1.6	1.4	1.2-1.6	10
Wilson, 2009	**Exposure to Violence at Home Under Age 12 Years**	Adolescent antisocial behaviour (e.g. violent crimes, interpersonal aggression, and/or non-violent delinquent acts)	18	18,245	d = 0.55	0.27-0.69	2.7	1.6-3.5	8
Derzon, 2001	**Youth Antisocial Behaviour (e.g. underage smoking, poor school attendance)**	Crimes against person in adulthood (e.g. interpersonal violence, battery and threatening behaviour)	58	38,254	r = 0.33		3.6	3.4-3.7	9

Appendix D – Parental Risk Factors for Violence

Cells left blank if data not published in original review. Abbreviations: k = Total number of studies analysed; N = Total number of cases; CI = Confidence Intervals; AMSTAR = Assessing the Methodological Quality of Systematic Reviews Scoring System

Author & Year	Risk Factor	Outcome Measure(s)	k	N	Original Effect Size	95% CI	Effect Size as OR	95% CI	AMSTAR Score
Hoeve, 2012	**Poor Attachment to Parents***	Delinquency (defined as any behaviour prohibited by the law)	74	55,537	r = 0.18		2.0	1.9 - 2.0	9
Murray, 2012	**Parental Incarceration**	Antisocial behaviour (defined as violation of social norms or laws, including criminal behaviour)	40	7374	OR = 1.6	1.4-1.9	1.6	1.4 - 1.9	8
Derzon, 2010	**Family Problems**	Violent, criminal, aggressive and problem behaviour	119	133,525	r = 0.15	(-0.1 - 0.5)	1.7	0.7 - 8.1	8
	Separation from Parents		3	2,428	r = 0.172		1.9	1.6 - 2.12	
	Harsh Erratic Discipline		8	3,467	r = 0.126		1.6	1.4 - 1.8	
	Mother Under 19 Years Old at Birth		2	23,073	r = 0.042		1.2	1.1 - 1.2	
	Parental Antisocial Behaviour		9	10,638	r = 0.167		1.8	1.7 - 2.0	
	Parental Maltreatment (including sexual abuse)		12	5,822	r = 0.100		1.4	1.3 - 1.6	
Pratt, 2010	**Antisocial Attitudes in Parents and Peers**	Crime & deviance (e.g. violent crime, drug use, sexual assault, property crime, theft or vandalism)	133	118,403	d = 0.23	0.21-0.24	1.5	1.5 - 1.6	6

* Attachment to parents was measured between ages of 6-38 years, delinquency measured between ages of 7-38 years. Attachment was assessed in different ways, e.g. self-report, observations or parental report.

Appendix E – Psychological Risk Factors for Violence

Cells left blank if data not published in original review. Abbreviations: k = Total number of studies analysed; N = Total number of cases; CI = Confidence Intervals; AMSTAR = Assessing the Methodological Quality of Systematic Reviews Scoring System

Author & Year	**Risk Factor**	**Outcome Measure(s)**	**k**	**N**	**Original Effect Size**	**95% CI**	**Effect Size as OR**	**95% CI**	**AMSTAR Score**
Morgan, 2000	**Poor executive function**	Antisocial behaviour (criminality and delinquency)	39	4589	d = 0.57		2.8	2.5-3.1	9
Stams, 2006	**Poor moral judgement**	Juvenile delinquency (conviction of any criminal violation e.g. drug offences)	50	4814	d = 0.76	0.63-0.88	4.0	3.1-5.0	9
Jolliffe, 2004	**Low empathy**	Criminal offences (including violent and sexual offences)	35	3168					6
		Violent offending	7		d = -0.39	-0.54--0.25	2.0	1.7-2.5	

Appendix F – Neuropsychiatric Risk Factors for Suicide

Cells left blank if data not published in original review. Abbreviations: k = Total number of studies analysed; N = Total number of cases; CI = Confidence Intervals; AMSTAR = Assessing the Methodological Quality of Systematic Reviews Scoring System

Author & Year	**Risk Factor**	**Outcome Measure(s)**	**K**	**N**	**Original Effect Size**	**95% CI**	**AMSTAR Score**
Saha, 2007	**Schizophrenia**	Mortality	20	85,000+			10
		Completed suicide	7		SMR = 12.9	12.3 – 13.5	
Bell, 2009	**Epilepsy**	Completed suicide	74	54,567	SMR = 3.3	2.8-3.7	9
Neelman, 2001	**Bipolar disorder**	Completed suicide	8	5065	SMR = 17.1	9.8-29.5	3
Kanwar, 2013	**Any anxiety disorder**	Completed suicide	14		OR = 3.3	2.1 – 5.3	7
Li, 2011	**Any personality disorder**	Completed suicide	13		RR = 4.1 (men), 1.8 (women)	3.0 – 5.8	5
Yoshimasu, 2008	**Multiple**	Completed suicide					7
	Substance abuse		14	2000	OR = 5.24	3.30-8.31	
	Depression		14	1823	OR = 13.4	8.1 – 22.4	
James, 2004	**Hyperkinetic disorder**	Completed suicide	5		RR = 2.91 in males under 24 years	1.47-5.7	4

Appendix G – Environmental Risk Factors for Suicide

Cells left blank if data not published in original review. Abbreviations: k = Total number of studies analysed; N = Total number of cases; CI = Confidence Intervals; AMSTAR = Assessing the Methodological Quality of Systematic Reviews Scoring System

Author & Year	Risk Factor	Outcome Measure(s)	K	N	Original Effect Size	95% CI	AMSTAR Score
Anglemyer, 2014	**Easy access to firearms**	Completed suicide	16		OR = 3.2	2.4-4.4	10
Milner, 2013	**Unemployment**	Completed suicide	16		OR = 1.7	1.2-2.2	8
Milner, 2013	**Occupation**	Completed suicide	34				8
	Unskilled Workers*				RR = 1.84	1.46-2.33	
Li, 2011	**Socioeconomic Factors**	Completed suicide					5
	Lowest income level (males)		4		RR = 2.18	1.47-3.22	
	Lowest income level (females)		3		RR = 1.45	0.95-2.21	
Yoshimasu, 2008	**Unmarried adults**	Completed suicide	13	2192	OR = 2.1	1.5-3.0	7

*Low socioeconomic status took into account; low income, education level to less than secondary schooling, current unemployment or low ranked occupation.

Appendix H – Historical Risk Factors for Suicide

Cells left blank if data not published in original review. Abbreviations: k = Total number of studies analysed; N = Total number of cases; CI = Confidence Intervals; AMSTAR = Assessing the Methodological Quality of Systematic Reviews Scoring System

Author & Year	Risk Factor	Outcome Measure(s)	K	N	Original Effect Size	95% CI	AMSTAR Score
Geulayov, 2012	**Parental fatal and non-fatal suicidal behaviour**	Suicidal behaviour and depression	14				7
		Completed suicide alone			OR = 2.32	1.99-2.70	
Paolucci, 2001	**Childhood sexual abuse**	Multiple (data taken for suicide only)	37	25,367			7
		Completed suicide alone	10	4008	d = 0.44*	0.40-0.48	
Li, 2011	**Socioeconomic Factors**	Completed suicide					5
	Education level to less than secondary school (males)		4		RR = 2.42	1.03-5.70	
	Education level to less than secondary school (females)		3		RR = 1. 5	0.94-2.34	
Yoshimasu, 2008	**History of suicide attempt(s) or self-harm**	Completed suicide	10	1611	OR = 16.33	7.51-35.52	7

*Cohen's d = 0.44 converted to odds ratio for data synthesis.

Appendix I – Intimate Partner Violence

Cells left blank if data not published in original review. Abbreviations: k = Total number of studies analysed; N = Total number of cases; CI = Confidence Intervals; AMSTAR = Assessing the Methodological Quality of Systematic Reviews Scoring System

Author & Year	Risk Factor*	Outcome Measure(s)	k	N	Original Effect Size	95% CI	Effect Size as OR	95% CI	AMSTAR Score
Stith, 2008	**Marital Factors**	Physical violence towards Intimate partner	32	12,740					8
	Increased marital conflict				r = 0.27		2.8	2.6-3.0	
	Decreased marital satisfaction in perpetrator				r = -0.27		2.8	2.6-3.0	
Moore, 2007	**Drug misuse in perpetrator**	Aggression (psychological, physical or sexual) towards intimate partner	96	79,698	d=0.27	0.25-0.29	1.9	1.8-2.0	8
Gil-Gonzalez, 2006	**Alcohol consumption in perpetrator**	Physical intimate partner violence	11		OR= 4.6	3.30-6.35	4.6	3.3-6.4	9
Stith, 2003	**Multiple**	Physical violence towards Intimate partner	85						8
	History of emotional/verbal abuse of partner		15	3257	d = 1.13	1.07-1.20	7.8	7.0-8.8	
	History of History of sexual abuse towards partner		6	2426	2426	d = 1.02	0.94-1.09	6.3	
	Drug use and misuse in perpetrator		5	4496	d = 0.65	0.58-0.73	3.3	2.9-3.8	
	Attitude condoning violence in perpetrator		5	2318	d = 0.63	0.55-0.71	3.1	2.7-3.6	

	Traditional sex-role ideology		7	1153	d = 0.60	0.51-0.70	3.0	2.5-3.6	
	Anger/hostility		11	2179	d = 0.54	0.45-0.63	2.7	2.3-3.1	
	Career/life stress		4	391	d = 0.54	0.39-0.70	2.7	2.0-3.6	
	Depression in perpetrator		4	2720	d = 0.48	0.40-0.56	2.4	2.1-2.8	
Stith, 2000	**Exposure to violence (growing up in a violent home)**		39	12,981	r = 0.18	(0.16 – 0.20)	1.9	1.8 – 2.1	6

*All of the risk factors listed in this table were measured by mixture of validated and unvalidated surveys and questionnaires. For example, traditional sex-role ideology was measured by the 'Attitudes Toward Women Scale—Short Version', 'Sex-role Stereotyping Scale', 'Husband's Patriarchal Beliefs Index' and 'Psychological Maltreatment Of Women Inventory'.

Appendix J – Sexual Violence and Homicide

Cells left blank if data not published in original review. Abbreviations: k = Total number of studies analysed; N = Total number of cases; CI = Confidence Intervals; AMSTAR = Assessing the Methodological Quality of Systematic Reviews Scoring System

Author & Year	**Risk Factor**	**Outcome Measure(s)**	**k**	**N**	**Original Effect Size**	**95% CI**	**Effect Size as OR**	**95% CI**	**AMSTAR Score**
Jaspersen, 2009	**Multiple**	Sexual offending	17	1037					7
	Sexual abuse history				OR = 3.4	2.2 – 4.8	3.4	2.2 – 4.8	
	Physical abuse history				OR = 1.5	0.9-2.6	1.5	0.9 - 2.6	
Whitaker, 2008	**Multiple**	Sexual offending against children vs non-offenders (people with NO convictions of any kind)	89						7
	Family problems				d = 0.51	(0.31 - 0.72)	2.5	1.8-3.7	
	Externalizing behavioural problems				d = 0.45	(0.36 - 0.54)	2.3	1.9-2.7	
	Internalizing behavioural problems				d = 0.39	(0.24 - 0.55)	2.0	1.5-2.7	
	Social problems				d = 0.58	(0.36 - 0.80	2.9	1.9-4.3	
	Sexual problems				d = 0.45	(0.06 - 0.84)	2.3	1.1-4.6	
	Tolerant attitudes sexual offending				d = 0.54	(0.37 - 0.72)	2.7	2.0-3.7	
Fazel, 2009	**Multiple**	Homicide							10
	Schizophrenia		5		OR = 19.5	14.7 - 25.8	19.5	14.7 – 25.8	
	Substance abuse				OR = 10.9	3.4 - 34.9	10.9	3.4 – 34.9	