

# The quality and effectiveness of interventions that target multiple risk factors among young people: a systematic review

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Most young people experience one or two behavioural risk factors, such as substance use or risky sexual behaviour, but the majority navigate adolescence with relatively few long-term negative consequences.<sup>1-5</sup> A small minority experience disproportionately higher rates of co-occurring risk, which increases their likelihood of experiencing detrimental outcomes later in life, such as homelessness, incarceration, or premature death.

For young people who experience these single risk factors (e.g. excessive alcohol consumption, cannabis use, depression or anxiety), single-focus interventions with an established evidence base, such as cognitive behaviour therapy (CBT) or motivational interviewing (MI), are available.<sup>1,2</sup> These interventions are typically delivered in a single, specialised and controlled environment, such as a school,<sup>6</sup> are relatively inexpensive to implement and have demonstrated benefits for young people across a wide range of populations.<sup>7</sup> For young people who experience multiple risk factors simultaneously (hereafter high-risk young people), however, these interventions have not been shown to be effective.<sup>8,9</sup> A recent review of interventions targeting co-occurring substance use and risky sexual behaviour among adolescents, found that interventions that aimed to address both risk factors simultaneously were more likely to be effective than those that aimed to address only one risk factor at a time.<sup>10</sup> While the above-cited review examined the evidence

## Abstract

**Objective:** To identify evaluations of interventions that target multiple risk factors in high-risk young people, describe their characteristics, critique their methodological quality and summarise their effectiveness.

**Methods:** A search of the literature published between 2009 and 2014 identified 13 evaluations of interventions that targeted multiple risk factors, compared to 95 evaluations that targeted single risk factors. The methodological adequacy of the 13 evaluation studies was analysed using the Quality Assessment Tool for Quantitative Studies and information regarding characteristics and intervention effectiveness was extracted and summarised.

**Results:** There were very few outcome evaluation studies of interventions that targeted multiple risk factors, relative to single risk factors, among high-risk young people. Of the identified studies, half were methodologically weak. Interventions delivered in community settings targeted a greater number of risk factors, while those delivered in a school or health setting reported a higher proportion of statistically significant outcomes. No economic analyses were conducted.

**Conclusions and Implications for Public Health:** More methodologically rigorous evaluations of interventions targeting multiple risk factors among high-risk young people are required, especially for those delivered in community settings. Four key areas for improvement are: i) more precisely defining the risk factors experienced by high-risk young people; ii) achieving greater consistency across interventions; iii) standardising outcome measures; and iv) conducting economic analyses.

**Key words:** high-risk young people, at-risk young people, intervention, systematic review

for interventions targeting two specific risk factors, there has been no synthesis of the evidence regarding interventions targeting multiple risk factors simultaneously.

This systematic review aims to identify evaluations of interventions that target multiple risk factors in high-risk young people, describe the characteristics of the interventions and their effectiveness, and critique the methodological quality of the evaluations.

## Method

### Search strategy

Figure 1 summarises the databases searched, the exclusion criteria applied and the classification of included articles.

Consistent with the methods detailed in the Cochrane Collaboration Handbook on Systematic Reviews of Health Promotion and Public Health Interventions,<sup>11</sup> the search strategy comprised two steps.

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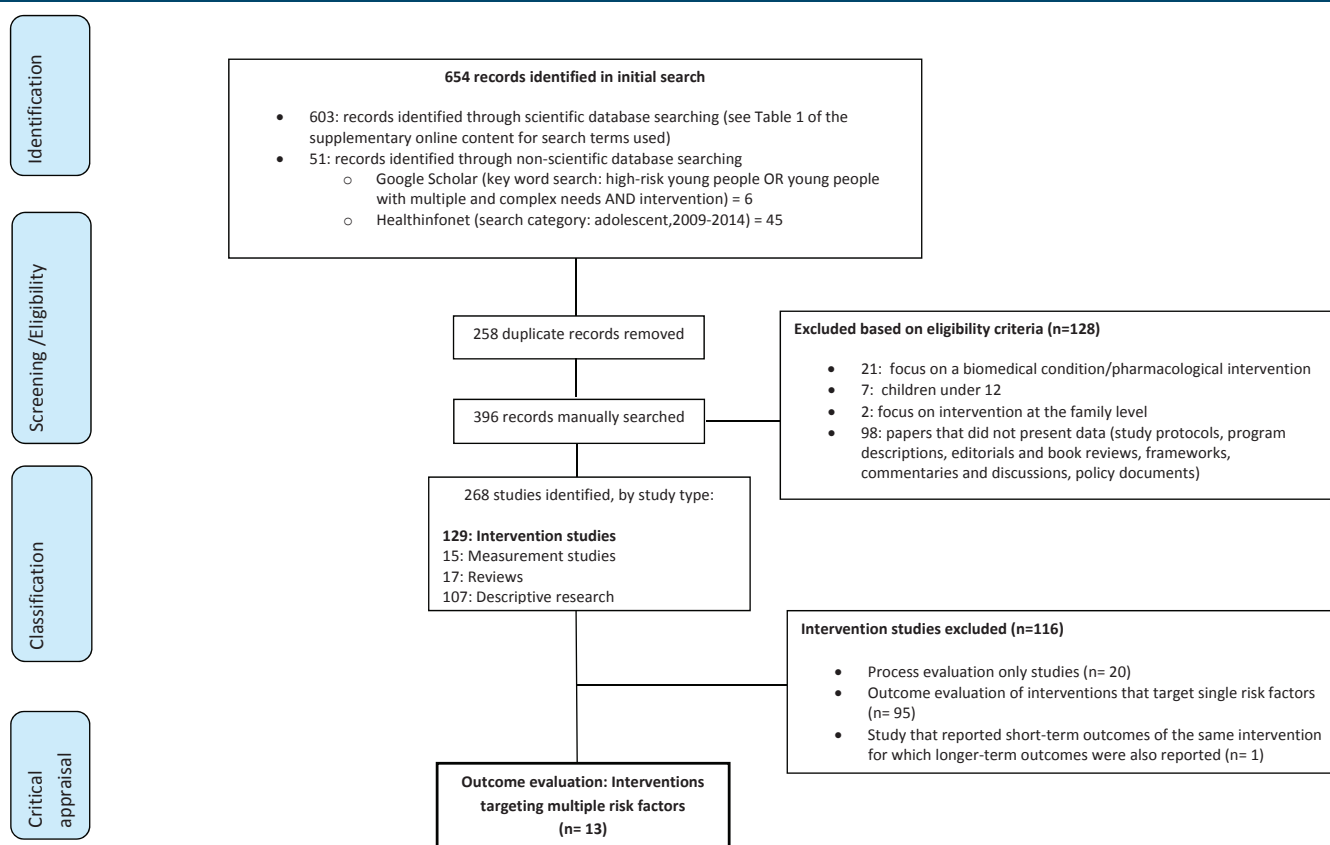
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Figure 1: PRISMA flow diagram summarising systematic search identifying intervention studies among the published literature relevant to high-risk young people.



First, seven scientific electronic databases were searched: Medline, PsycINFO, Social Work Abstracts, Global Health, CINCH, CINCH-ATSIS, and FAMILY. Electronic databases were searched individually so that database-specific search strings could be used, except for the last three, which were searched simultaneously using the Informit online database.

As detailed in Table 1 of the online supplementary content, the search strings were designed to allow for the imprecise definition of the population of young people being searched (i.e. they are variously referred to as, 'high-risk young people', 'young people with multiple and complex needs', or 'at-risk young people') and no age range was specified. The combined searches of all databases located 603 articles, of which 258 duplicates were removed. Searches were limited to the years 2009-14 for two reasons: first, to ensure a realistic number of articles would be identified for categorisation and critique; and second, to optimise the likelihood the included studies represent best-evidence practice because they are informed by earlier research findings.

Second, the grey literature was searched to identify articles that were not located by the electronic search. All publications within

the 'Adolescent' section of the 'Population Groups' tab on the HealthInfoNet website were searched, and the search terms synonymous with 'high-risk young people' and 'intervention' were entered together into Google Scholar. Searching the grey literature identified 51 articles.

### Classification of studies

The title and abstracts of the 396 identified articles were then used to classify articles using a three-step process.

#### Step 1: applying eligibility criteria

Papers were excluded if: a) the study of interest focused on a biomedical or pharmacological intervention (n=21); b) the study focused on young people outside the age range of 12-24 years (this age range was selected because it is the definition of a young person used in national reports in Australia<sup>12</sup>) (n=7); c) the intervention was a family-based intervention with a primary objective of improving outcomes for the parents/carers (n=2) or; d) the study did not present data (study protocols, program descriptions, editorials and book reviews, frameworks, commentaries and discussions, policy documents) (n=98). A total of 128 articles were excluded at this step.

#### Step 2: identifying intervention studies

The remaining 268 articles were classified by their study type using categories adapted from similar reviews:<sup>8,13</sup> a) measurement studies, included papers that were primarily concerned with developing measurement instruments that could be used to evaluate interventions (n=15); b) reviews, defined as narrative and systematic literature reviews, meta analyses, or rapid evidence syntheses (n=17); c) descriptive research, defined as papers that described the characteristics of potential interventions or young people that the interventions could target (n=107); and d) intervention studies, defined as a process evaluation study (any evaluation activity conducted for the purpose of determining the acceptability, dose, fidelity, and/or reach of an intervention) or an outcome evaluation study (reported a quantitative intervention outcome) (n=129). All non-intervention studies (n=139) were excluded at this point.

#### Step 3: identifying outcome evaluations of interventions targeting multiple risk factors

The full-text versions of the 129 intervention studies were obtained and articles that only reported a process evaluation were excluded from further analysis (n=20). All

outcome evaluation studies ( $n=109$ ) were read in full, and classified according to the number of risk factors the intervention sought to impact. For the purposes of this review, the risk factors that were targeted were identified from the objective(s) of an intervention, as described in the Introduction, or intervention description section of the Methods in each article. Information on the outcomes measured was not used to identify the risk factors targeted. To guide the process of determining the number and type of risk factors the intervention in each study targeted, a heuristic classification tool was developed by the authors (see Table 2 of the supplementary online content) for six common risks factors associated with high-risk young people identified in existing studies: criminal activity; education and employment; mental health and wellbeing; risky sexual behaviour; substance use; and violence.<sup>1-3</sup> For example, if an intervention had the sole objective of reducing cannabis use, it was classified as targeting a single risk factor: substance use. Alternatively, if an intervention had the multiple objectives of reducing cannabis use, improving mental health and reducing violent behaviour, it was classified as targeting multiple risk factors: substance use; mental health and wellbeing; and violence. The 95 studies that evaluated an intervention targeting a single risk factor were excluded, even if outcomes from multiple domains were measured.

Of the remaining 14 outcome evaluations of interventions that targeted multiple risk factors, the outcomes of one intervention were published in two separate articles<sup>14,15</sup> and, consequently, only the paper reporting the longer follow-up period was included. The rationale behind this decision was that the paper reporting the longer follow-up period was more likely to report accurate change attributable to the intervention.<sup>15</sup> A total of 13 papers were identified for review.

### Key characteristics of interventions

Criteria used for data extraction were adapted from the Cochrane Collaboration Handbook for Systematic Reviews of Health Promotion and Public Health Interventions.<sup>11</sup> Information extracted and presented in Table 1 includes: first author, year of publication and country where the intervention was implemented; sample size and setting; age range or mean age of participants and the proportion that was male; intervention description; and the risk factors targeted by the intervention.

### Critique of the methodological quality of studies

Methodological quality was assessed using the Quality Assessment Tool for Quantitative Studies.<sup>16</sup> Sections A-F (A, selection bias; B, study design; C, confounders; D, blinding; E, data collection methods; F, withdrawal and dropouts) were coded weak, moderate or strong as guided by the component rating scale. Section G (intervention integrity) and H (analysis) require a brief description of adequacy rather than coding, the definitions of which are guided by the Tool. Summary ratings comprise weak (studies that receive two or more weak scores), moderate (studies that receive one weak score) or strong (studies that receive no weak scores). In order to quantify the likely extent of classification error, the methodological quality of the studies, as assessed by author AK, was reassessed by author CF as a blinded coder. This resulted in 95% agreement on ratings for components A-F, and 92% agreement on the summary ratings for each study. Where there was disagreement, the first author's classifications were used.

### Effectiveness of interventions

Given the interventions – populations targeted and outcomes measured varied substantially across studies – a meta-analysis was not appropriate. Consequently, evidence regarding the effectiveness of interventions that targeted multiple risk factors was summarised by identifying the outcomes on which the intervention had a statistically significant effect (i.e.  $p<0.05$ ) and whether an economic evaluation was conducted. To avoid over-interpreting poor-quality evidence, only the six studies that received an overall methodological summary rating of moderate or strong were included in the synthesis of intervention effectiveness (summarised in Table 2), although data for methodologically weak studies were included in results tables for comprehensiveness.

## Results

### Characteristics of interventions

Six of the 13 interventions that targeted multiple risk factors were delivered in a school setting, two in a health setting (one in a clinic and one in an Emergency Department), and five in a community setting. For the purpose of this review, interventions delivered in a community setting are defined as services operated by professionals in various settings

across a community, rather than only delivered within a single setting (e.g. a school or a hospital).<sup>6</sup> Participants' ages ranged from 10 to 35 years and the proportion that was male ranged from 0% to 83%. This information is summarised in Table 1.

### Critique of the methodological quality of outcome evaluations

Two studies obtained an overall classification of strong for methodological quality,<sup>17,18</sup> four obtained an overall classification of moderate<sup>15,19-21</sup> and seven were classified as weak.<sup>22-28</sup> Only one study of a community-based intervention received a methodological rating higher than weak.<sup>21</sup> Further detail on the methodological quality of studies is available in Table 3 of the supplementary online content.

### Effectiveness of interventions

The effectiveness of interventions is summarised in Table 2, separately for the six studies rated as methodologically strong or moderate and for the seven studies rated as weak.

### Effectiveness by intervention for methodologically strong/moderate studies ( $n=6$ )

A school-based, brief, web intervention for students aged 15-16 years in the Netherlands statistically significantly improved rates of self-reported safe sex, mental health status, and health related quality of life.<sup>17</sup> Similarly, a school-based, group cognitive-behavioural depression prevention program for students aged 14-19 years statistically significantly reduced self-reported substance use and improved depressive symptoms.<sup>18</sup> A brief intervention delivered in an Emergency Department for people 14-18 years statistically significantly reduced rates of self-reported peer aggression and peer victimisation.<sup>15</sup> An MI intervention, integrated with social networking counselling and delivered in a health clinic for females aged 14-18 years, statistically significantly reduced rates of self-reported trouble due to alcohol use, substance use before sex, offers to use marijuana, and improved social stress and readiness to start counselling.<sup>19</sup> A school-based intervention that combined CBT with relaxation techniques, problem-solving skills, knowledge about depression and positive self-esteem, and study skills and school-work techniques for students, statistically

Table 1: Characteristics of identified interventions.					Table 2: Effectiveness of identified interventions, by methodological strength.
First author & year of publication (Country)	Sample/setting	Age Range or mean age (% male)	Intervention description	Domains of risk targeted by intervention	Outcomes & effectiveness*
Bannink 2014 <sup>17</sup> (The Netherlands)	Students (n=1256) Schools (n= 12)	15-16 years (54.7%)	Web-based brief intervention: health messages tailored to responses given on a questionnaire, plus feedback compared to normative sample, and the option of MI for young people with poor mental health	1. Mental health and wellbeing 2. Substance use 3. Risky sexual behaviour	- Mental health status* - Health related quality of life* - Alcohol use - Drug use - Smoking - Safe sex*
Cunningham 2012 <sup>15</sup> (US)	Urban adolescents presenting for illness or injury (n=726) Emergency Department (n=1 )	14-18 years (43.5%)	Brief intervention based on MI delivered by a therapist with computer assistance	1. Substance use 2. Violence	- Alcohol misuse - Binge drinking - Alcohol related consequences - Peer aggression* - Peer victimisation* - Violence consequences
Mason 2011 <sup>19</sup> (US)	Female adolescent patients (n=28) Health clinic (n=1)	14-18 years (female only)	MI integrated with social network counselling: rapport building, presentation of substance use feedback from baseline assessment, introduction of social network information, developing future plans	1. Substance use 2. Mental health & wellbeing	- Overall substance use - Trouble due to alcohol use* - Substance use before sex* - Offers to use marijuana* - Readiness to start counselling* - Overall social network quality - Social stress*
Poirier 2013 <sup>20</sup> (Canada)	Students (n=53) Schools (n=4)	Mean=14 years (17%)	Pare-Chocs: CBT, problem solving techniques, study skills and schoolwork techniques, and education on depression, positive self-esteem and body-image	1. Mental health & wellbeing 2. Education & employment	- Cognitive distortions* - Problem solving strategies* - Frequency of depressive symptoms - School drop-out risk
Rohde 2012 <sup>18</sup> (US)	Students (n=341) Schools (n=6)	14-19 years (44%)	Group cognitive-behavioural depression prevention program: building group rapport, increasing pleasant activities, learning cognitive restructuring techniques, and developing plans for future stressors	1. Substance use 2. Mental health & wellbeing	- Substance use* - Depressive symptoms*
Schaeffer 2013 <sup>21</sup> (US)	Juvenile offenders (n=97) Community-based	15-18 years (83%)	CRAFT: classroom based construction skill training, academic skill development, employability skill development, job placement assistance, assistance with job retention, personal development, case management	1. Education & employment 2. Substance use 3. Mental health & wellbeing 4. Criminal activity	- Employment* - Education outcomes* - Substance use - Mental health symptoms - Criminal activity and recidivism
Faulkner 2012 <sup>22</sup> (Australia)	Students (n=60) Schools (n=3)	Mean=12	DRUMBEAT: Music therapy and CBT	1. Mental health & wellbeing 2. Education & employment	- Self-esteem - School attendance - Anti-social behaviour at school - Cooperation and collaboration in the classroom
Grace 2014 <sup>23</sup> (Australia)	Unemployed, homeless young people in Victoria (n=396) Community-based	10-35 years (73% aged 18 to 24) (65%)	Joined-up case management: intensive client centred case management from one point of contact	1. Homelessness 2. Mental health & wellbeing 3. Education & employment	- Stability of housing - Affordability of housing - Health & wellbeing - Community connectedness - Income from employment - Participation in education and training
Green 2014 <sup>28</sup> (UK)	Young people in foster care (n=219) Community-based	10-17 years	MTFC: specialist training and support for foster parents, individual and family therapy, social skills training, diversionary activities, case management, and education support	1. Mental health & wellbeing 2. Education & employment 3. Criminal activity	- Mental health - Social and physical functioning - Scholastic outcomes - Attendance - Offending
Rhoades 2013 <sup>24</sup> (UK)	Adolescent girls in foster care (n=58) Community-based	12-16 years (female only)	MTFC: specialist training and support for foster parents, individual and family therapy, social skills training, diversionary activities, case management, and education support	1. Violence 2. Criminal activity 3. Substance use 4. Risky sexual behaviour 5. Mental health & wellbeing 6. Education & employment	- Violence* - Offending* - Substance use - Risky sexual behaviour* - Self-harm* - Participation in school activities*



significantly improved rates of self-reported cognitive distortions and problem-solving strategies amongst young people with an average age of 14 years.<sup>20</sup> Finally, a community-based intervention that involved apprenticeship-focused training for juvenile offenders aged 15-18 years statistically significantly improved rates of self-reported employment and educational outcomes.<sup>21</sup>

### Effectiveness by risk factor for methodologically strong/moderate studies (n=6)

The most commonly measured outcomes were associated with the risk factors of mental health and wellbeing (n=10) and substance use (n=12). There were three outcomes measured associated with the

risk factor of education and employment, three outcomes measured associated with the risk factor of violence, and one outcome measured for the risk factors of criminal activity and risky sexual behaviour.

Of the 10 outcomes measured associated with the risk factor of mental health and wellbeing, seven (70%) achieved a statistically significant improvement. Of the 12 outcomes measured associated with the risk factor of substance use, four (33%) achieved a statistically significant improvement. Of the three outcomes measured associated with the risk factor of education and employment, two (66%) achieved a statistically significant improvement, as was the case for the risk factor of violence. The one outcome measured associated with the risk factor of

risky sexual behaviour achieved a statistically significant improvement, unlike the outcome measured associated with the risk factor of criminal activity.

### Effectiveness by intervention setting for methodologically strong/moderate studies (n=6)

Community-based interventions targeted a greater number of risk factors (mean=4) than both school-based interventions (mean=2) and health-based interventions (mean=3). A higher proportion of the outcomes measured in the evaluations of school-based interventions and health-based interventions were significant (n=7, 44% for both), relative to the community-based interventions (n=2, 13%).

Table 1 continued: Characteristics of identified interventions.					Table 2 continued: Effectiveness of identified interventions, by methodological strength.
First author & year of publication (Country)	Sample/setting	Age Range or mean age (% male)	Intervention description	Domains of risk targeted by intervention	Outcomes & effectiveness*
Wiggins 2009 <sup>25</sup> (UK)	Young people at risk of teen pregnancy, substance misuse or exclusion from school. (n=2,724) Community-based	13-15 years (60%)	Young Peoples Development Programme: education, training/employment opportunities, life skills, mentoring, volunteering, health education, arts, sports, and advice on accessing services	1. Risky sexual behaviour 2. Substance use 3. Mental health & wellbeing 4. Education & employment 5. Criminal activity	- <b>Heterosexual sex before 16 (significant increase for women only)*</b> - No. sexual partners - Condom use - Perceived difficulty in initiating condom use - <b>Expectations of being a parent by age 20 (significant increase for women only)*</b> - Cannabis use weekly in past 6months - Drunkenness monthly in past 6months - Worry often in past few weeks - Often angry in past few weeks - Difficulty discussing personal things with close friends - Dislike school - <b>Tuancy in past 6 months*</b> - <b>Temporary school exclusion in past 6 months (significant increase for women only)*</b> - Expectation of being in a steady job by age 20 - Contact with police
Williamson 2013 <sup>26</sup> (US)	Students (n=31) Alternative school (n=1)	14-18 years (94%)	PLC program: 10 group sessions of CBT assisted by workbook	1. Violence 2. Mental health & wellbeing	- <b>Propensity for physical aggression*</b> - <b>Propensity for verbal aggression*</b> - Aggressive behaviour - <b>Sense of self*</b> - Self-control - <b>Decision making*</b> - <b>Moral beliefs*</b> - Prosocial connectedness
Wood 2013 <sup>27</sup> (Australia)	Students (n=180) Primary schools (n=10) Secondary schools (n=5) Intensive English centres (n=4)	Not specified.	DRUMBEAT: music therapy and CBT	1. Mental health & wellbeing 2. Education & employment	- <b>Self-esteem*</b> - <b>School behaviour incidents*</b> - School absences

Key to abbreviations: CBT – Cognitive Behavioural Therapy; CRAFT – Community Restitution Apprenticeship-Focused Training; MI – Motivational Interviewing; MTFC – Multidimensional Treatment Foster Care; PLC – Positive Life Changes

\* [bold] Indicates a statistically significant result (at the level of  $p < 0.05$ ), if a statistical comparison is reported.  
Shaded cells represent studies with a methodological rating of weak (n=7)

### **Cost analysis for methodologically strong/moderate studies (n=6)**

No studies included a cost or economic analysis.

## **Discussion**

This systematic review found that of the 108 intervention studies identified, only 12% (n=13) were outcome evaluations of interventions targeting multiple risk factors in high-risk young people, compared with 88% (n=95) targeting a single risk factor, and half the 13 identified studies were methodologically weak.

### **Key characteristics of interventions**

The 13 interventions that targeted multiple risk factors in high-risk young people were delivered across multiple geographic regions and in a range of settings, including schools (n=6), hospitals and health clinics (n=2), and in the community more broadly (n=5). Each targeted a different combination of risk factors, with an extensive range of intervention activities. While this lack of homogeneity between interventions reflects a broad spectrum of intervention activity for high-risk young people, it also limits the capacity for direct comparisons about their relative effectiveness.

### **Critique of the methodological quality of outcome evaluations**

More than half the evaluations used either a Randomised Controlled Trial or Clinical Controlled Trial design, and the majority adequately controlled for confounding, utilised valid and reliable self-report measures, and reported adequate descriptions of the withdrawal and dropout of participants. The weakness of most studies was the selection bias generated by their participant selection procedures and their failure to adequately blind both participants and assessors to the research question. While ethical and practical considerations can often render these two aspects of public health evaluations problematic,<sup>6</sup> these limitations can still reduce the validity of the data collected. Reporting on intervention integrity was also mixed, with only half the studies measuring the implementation fidelity of the intervention, which limits the transferability of their findings to other communities or settings. Furthermore, although valid and reliable self-report measures were used in the majority of studies that collected self-report

data, half the studies relied solely on self-report measures. Since self-report data can be prone to bias,<sup>29</sup> even where data collection tools are of demonstrated reliability and validity, future intervention studies should consider using a combination of self-report and more objective measures, such as routinely collected crime or health services data. This would also improve the capacity of studies to capture community-level benefit.

Generally, studies of interventions delivered in a school or health setting were of relatively high methodological quality, whereas only one of the five community-based interventions achieved a methodological quality rating higher than weak.<sup>21</sup> This methodological disparity may reflect that school- or health-based interventions are delivered in more controlled environments, which allows greater consistency in intervention implementation, improved intervention fidelity, higher follow-up rates, and greater statistical power in evaluations; or it may reflect a higher degree of complexity among the high-risk young people who are accessed through community-based settings (e.g. they can be highly transient which makes adequate follow-up rates harder to achieve).

### **Effectiveness of interventions**

There were far more outcomes measured associated with the risk factors of mental health and wellbeing (n=10) and substance use (n=12), than outcomes associated with other risk factors. This could indicate that these are the most common risk factors among high-risk young people, that interventions target these risk factors more frequently, or that there are more readily available outcome measures for these risk factors.

Although wide variation in the outcomes measured and the instruments used meant results from different interventions could not be pooled, a simple count of significant findings suggested that interventions targeting multiple risk factors in high-risk young people are more effective at improving outcomes associated with the risk factors of risky sexual behaviour, mental health and wellbeing, education and employment, and violence, than substance use. Indeed, this review highlights that outcomes associated with the risk factor of substance use were only statistically significantly reduced about one-third of the time that they were measured. There was no evidence that these interventions had an impact on outcomes associated with the risk factor of

criminal activity. In terms of intervention setting, interventions delivered in a school or health setting were associated with a higher proportion of statistically significant results (both n=7, 44%), than interventions delivered in a community setting (n=2, 13%). Nevertheless, the interventions delivered in community settings targeted a greater number of risk factors simultaneously. Again, this finding is consistent with the idea that interventions delivered in school or health-based settings are delivered in a more controlled environment allowing greater consistency of implementation and continuity of care which, in turn, increases the likelihood of achieving statistically significant improvements in risk factors. It is also likely that young people still engaged in school are at least minimally connected with a supportive care-giver, which is also likely to have a protective effect. Conversely, community-based interventions are often delivered across multiple settings in the community, and they tend to engage with young people who experience a higher degree of complexity (i.e. they target a greater number of risk factors than other interventions) and have fewer reliable social support structures, all of which increase the difficulty of achieving statistically significant improvements in risk factors.

No studies reported on the cost of their interventions, nor conducted an economic analysis to weigh the costs of these interventions against their benefits. Given the high economic costs to society likely to accrue over the lifetimes of high-risk young people, the potential economic benefits from intervening early are likely to be substantial, and obtaining such data would help support the case for funding programs for high-risk young people that have been shown to be effective.<sup>30-32</sup>

### **Limitations**

The lack of an agreed and specific definition for high-risk young people meant a broad combination of search terms was required. Since this requirement led to the identification of a high number of studies, the search was limited to studies published between 2009 and 2014. Although these studies only comprise relatively recently implemented interventions, they are likely to represent best-evidence practice based on the assumption that they are informed by earlier research findings.

The wide variation in interventions, and in the outcomes measured, limits the ability

to draw direct comparisons about the effectiveness of different interventions for different populations of high-risk young people. This finding highlights the need for greater consistency in defining intervention programs. Given the possibility that the wide variability in intervention programs is due to uncertainty about the precise nature of the most important risk factors experienced by high-risk young people, one solution is to more precisely define and prioritise those risk factors. A complementary solution to improving the comparability of interventions across different settings, while simultaneously allowing interventions to be tailored to available resources and the specific needs of the high-risk young people being targeted, is to design them using the principles of complex interventions.<sup>33</sup> This approach is yet to be applied to interventions for high-risk young people.

## Conclusions

Outcome evaluation studies of interventions targeting multiple risk factors in high-risk young people comprised only 12% (n=13) of intervention studies published between 2009 and 2014. The methodological quality of half these evaluations was weak (n=7). Increasing the number of evaluations published, and the proportion of them that are of good methodological quality, seems most likely to be achieved by four key actions: i) more precisely defining the risks experienced by high-risk young people; ii) achieving greater consistency across interventions by utilising the principles of complex interventions; iii) standardising the measures used to evaluate intervention effects; and iv) conducting economic analyses. Given promising evidence from this review that interventions targeting multiple risk factors can improve a range of outcomes for high-risk young people, achieving these four actions would help realise the potential of these interventions.

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## Supporting Information

Additional supporting information may be found in the online version of this article:

**Supplementary Table 1:** Databases and search strings utilised in search strategy.

**Supplementary Table 2:** Classification Tool for risk factors.

**Supplementary Table 3:** Critique of the methodological quality of studies.