Universal and selective interventions to prevent poor mental health outcomes in young people: systematic review and meta-analysis. *Harvard review of psychiatry*.
UNIVERSAL AND SELECTIVE INTERVENTIONS TO PREVENT POOR MENTAL HEALTH OUTCOMES IN YOUNG PEOPLE:
SYSTEMATIC REVIEW AND META-ANALYSIS
ABSTRACT

Background: The efficacy of interventions to prevent poor mental health outcomes in young people targeting asymptomatic individuals with high-risk of developing a mental disorder (selective prevention) and the general population (universal prevention) is not determined.

Methods: PRISMA/MOOSE-compliant systematic review and meta-analysis of Web of Science until 04/31/2019 to identify studies comparing post-test efficacy (Hedges' g=ES) of universal or selective interventions for poor mental health outcomes vs a control group, in samples with mean age <35 years (PROSPERO: CRD42018102143). Random-effects models, I² statistics, publication bias, meta-regression, sensitivity analyses (using Comprehensive Meta-Analysis_v.3); quality assessments, number needed to treat (NNT) and population impact number (PIN).

Results: 295 articles (447,206 individuals, mean age=15.4) appraising 17 poor mental health outcomes. Compared to control conditions, universal and selective interventions improved (in descending magnitude order) interpersonal violence (ES=0.431, p=0.021), general psychological distress (ES=0.421, p<0.001), alcohol use (ES=0.401, p<0.001), anxiety features (ES=0.393, p<0.001), affective symptoms (ES=0.304, p<0.001), other emotional and behavioural problems (ES=0.304, p<0.001), consequences of alcohol use (ES=0.282, p=0.019), post-traumatic stress disorder features (ES=0.279, p=0.017), conduct problems (ES=0.21, p<0.001), tobacco use (ES=0.208, p=0.002), externalising
behaviours (ES=0.137, p=0.001), attention-deficit/hyperactivity disorder (ADHD) features (ES=0.132, p<0.001) and cannabis use (ES=0.07, p=0.013), but not eating-related problems (ES=0.147, p=0.589), impaired functioning (ES=0.018, p=0.929), internalising behaviour (ES=0.001, p=0.32), and sleep-related problems (ES=0.11, p=0.078). Psychoeducation had the highest effect size for ADHD features (ES=0.202, p=0.004), affective symptoms (ES=0.611, p<0.001) and interpersonal violence (ES=0.676, p=0.024); psychotherapy had the highest effect size for anxiety features (ES=0.453, p<0.001).

**Conclusion:** Selective and universal preventive interventions for young individuals are feasible and can improve poor mental health outcomes.

**Keywords:** Prevention, Universal, Selective, Intervention, Meta-analysis.
INTRODUCTION

Prevention of poor mental health outcomes has become a cornerstone of modern clinical psychiatry\textsuperscript{1-3}. Poor mental health is defined as having a clinically diagnosed mental health problem\textsuperscript{4} or a mental disorder. The prevalence of mental conditions was estimated to be more than 13\% in children and adolescents\textsuperscript{5}. Once established, the appearance of mental disorders in young people has negative effects in their functioning and quality of life\textsuperscript{6}. Additionally, they result in a substantial economic burden on our society\textsuperscript{7}.

Preventive approaches in psychiatry can be divided according to the classic public health classification as well as according to Gordon's classification of physical illness (Table 1)\textsuperscript{2}. One of the most established paradigms involves preventive interventions for individuals with subthreshold or minimal symptoms who are at Clinical High-Risk for Psychosis (CHR-P)\textsuperscript{8,9}. This type of intervention is termed as primary indicated prevention of psychosis\textsuperscript{10} (Table 1), and several meta-analyses have already been carried out on indicated preventive interventions for psychosis\textsuperscript{11-13}. The current study does not review indicated preventive approaches. Rather, the present review focuses on universal and selective interventions that are provided to individuals without a-priori identified symptoms. Universal prevention targets individuals in the general population or in a whole population group that has not been identified based on increased risk\textsuperscript{2}. Selective prevention targets individuals or subgroups of the population who are at risk of developing a mental disorder due to biological, psychological or social risk factors\textsuperscript{2}.
While indicated prevention of severe mental disorders in young people has already received substantial empirical validation, the efficacy of universal and selective preventive strategies to prevent the emergence of mental disorders in individuals without identified symptoms is not fully established\textsuperscript{14}. Most of the available studies on selective or universal prevention have focused on the prevention of depression and related affective symptoms, but the findings are conflicting\textsuperscript{15-18}. Among the specific types of selective or universal interventions, psychopharmacological treatments are rarely used\textsuperscript{19}, whereas psychotherapy\textsuperscript{20} or psychoeducation\textsuperscript{21} are more frequent. Other interventions may include parent training\textsuperscript{22}, physical activity\textsuperscript{23} or mindfulness-based interventions\textsuperscript{24}, but their efficacy is again not fully consolidated. It is also not clear for which outcomes universal or selective approaches may be more effective.

A previous meta-analysis evaluated the efficacy of universal and selective interventions to promote good mental health\textsuperscript{25}, defined as a state of well-being that allows individuals to cope with their life and function properly\textsuperscript{26}. Also, conceptual or narrative reviews have been published in the prevention of mental disorders’ field\textsuperscript{1}. However, to our knowledge, no systematic review and meta-analysis has comprehensively appraised the efficacy of primary universal and selective preventive interventions for poor mental health outcomes in young people. This study provides the first meta-analytical evidence of the consistency and magnitude of the efficacy of primary universal and selective interventions for the prevention of a broad array of poor mental health outcomes. We focused on
young people because they are more likely to benefit from such preventative approaches.

METHODS

This Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)\textsuperscript{27} (eTable I) and Meta-analyses Of Observational Studies in Epidemiology (MOOSE) checklist\textsuperscript{28} (eTable II)-compliant systematic review was registered on PROSPERO (CRD42018102143). We followed EQUATOR Reporting Guidelines\textsuperscript{29}.

Search strategy and selection criteria

We performed an independent systematic two-step literature search using the following keywords: "mental health" AND "prevention." Web of Science database (Clarivate Analytics) was searched. Web of Science database incorporates the Web of Science Core Collection, MEDLINE®, the BIOSIS Citation Index, the Russian Science Citation Index, the SciELO Citation Index, and the KCI-Korean Journal Database, up to 04/31/2019. We further searched references from the included studies and systematic reviews or meta-analyses that were screened during the literature search manually. The same researchers who carried out the literature search screened, first looking at the title and abstract, and then to the full text all the articles. Discrepancies were resolved through consensus.

Condition and individuals being studied

Inclusion criteria were: a) original interventional studies (i.e. studies in which the investigators assign the interventions\textsuperscript{30}, see eMethods1) reporting on universal or
selective interventions (defined as in Table 1) of poor mental health outcomes, b) including both an intervention group and a control group (with or without randomisation; with single blinding, double-blinding, open-label studies or cross-over studies), c) reporting data that could be meta-analysed (e.g., mean values and their standard deviation, Odds Ratios or Risk Ratios metrics), d) investigating groups of individuals with an average age <35 years (or pre-school/school/college/undergraduate student samples) in line with the upper age limit of the early psychosis paradigm\(^ {32}\) (no lower age limit), e) written in English language.

Exclusion Criteria were: a) pilot data, reviews or conference proceedings; b) interventions conducted on individuals with a known mental disorder or presenting with subthreshold psychiatric conditions (clinical or subclinical, indicated interventions); c) samples with mean age ≥35 years; d) language other than English; e) overlapping samples; f) no control group. We searched for overlap looking at the name of the program or the intervention as well as to the population and location in which it was carried out. When overlap was found, we selected the largest and most representative study and excluded the others.

**Data extraction**

Data was extracted independently from all the studies included by independent researchers. Both databases were then crosschecked by experienced clinical researchers, and discrepancies were resolved through consensus. Variables included in the study were the following: author and year of the study; country; type of primary intervention (universal, selective); intervention content (psychoeducation, psychotherapy, other, combined); intervention name; type of control group (active control, treatment as usual, no intervention); sample size;
sex (% male); age (mean age, SD or range); quality assessment (details can be found below); type of poor mental health outcome. Our outcome categories included 17 domains that were pragmatically defined and operationalised as indicated in each individual study: attention-deficit/hyperactivity (ADHD) features, affective symptoms, alcohol use, consequences of alcohol use, anxiety features, cannabis use, conduct problems, eating-related problems, interpersonal violence, externalising behaviours, general psychological distress, impaired functioning, internalising behaviours, other emotional and behavioural problems, post-traumatic stress disorder (PTSD) features, sleep-related problems, tobacco use. Therefore, these categories represent the outcomes of universal and selective preventative approaches in young people that have been most widely and pragmatically investigated.

**Risk of bias (quality) assessment**

We rated randomisation, as we had planned and detailed in our protocol, according to the following scoring system: 0 for studies without a proper randomisation or studies that did not clarify if randomisation was carried out or not; 1 for studies that mentioned they carried out some randomisation but did not clearly specify the type; 2 for studies that detailed clearly their method of randomisation. We also rated blinding using the following scoring system: 0 for studies without a proper blinding or studies that did not clarify if blinding was carried out or not; 1 for studies with single blinding; 2 for studies with double or triple blinding.

**Strategy for data synthesis**
When three or more studies were available, the primary effect size (ES, Hedge's g) was estimated. Positive values indicated a post-test improvement in the intervention group versus the control group. Hedge's g is the standardised mean difference (SMD, the difference between the means of the intervention and control groups divided by the standard deviation) with correction for small-sample size bias. Categorical outcomes can be converted to SMD and then pooled. In this study, log odds ratios (LogOddsRatio) were converted into SMD with the mathematical formula $SMD = \text{LogOddsRatio} \times \left(\sqrt{3/\pi}\right)^{34}$. These values were then computed along with continuously evaluated outcomes. The meta-analyses included overall summary effects stratified by the different types of poor mental health outcomes. Sensitivity analyses stratified for (i) the type of intervention provided (psychoeducation vs psychotherapy vs combined vs others), (ii) the type of intervention (universal vs selective) and (iii) the age group of the population (children and adolescents - including studies in which all individuals are $\leq 18$ years old, vs adults - including studies in which all individuals are $\geq 18$ years old). Heterogeneity among study point estimates was assessed using the Q statistic. The proportion of the variability in ES estimates was evaluated using the index $I^2$ ($I^2>50\%$ represents significant heterogeneity). Random-effects models were employed due to high heterogeneity in the included studies. We assessed publication bias by the Egger's test and the "trim and fill" method to correct for the presence of missing studies when a risk of publication bias was detected. We conducted meta-regressions to estimate the association between the efficacy of the interventions and study quality. For these analyses, scores from randomisation and scores from blinding were added. This resulted in a total value ranging from 0-4.
As an additional analysis, for the outcomes that were improved by universal and selective interventions, we estimated the number needed to treat (NNT)\textsuperscript{38}, defining the bad outcome through the control event rate (CER) as the score at the top 10%, 20% and 30% percentile. We then converted NNT into population impact number (PIN)\textsuperscript{39} to estimate the percentage of the population to whom the intervention could be reasonably applied (30%, 50% and 70%). NNT is the average number of those receiving the intervention among whom one bad outcome will be prevented by the intervention, while PIN is the average number of those in the whole population among whom one bad outcome will be prevented by the intervention. Analyses were performed with the Comprehensive Meta-Analysis Version 3 (Biostat, Englewood, NJ, USA) two-sided statistical tests and with a significance level of alpha=0.05.

**RESULTS**

The literature search yielded 52,725 citations (51,469 through database searching, 1,256 through other sources), which were screened for eligibility, and 295 articles were finally included in the meta-analysis (Table 2): 175 (59.3%) adopted selective approaches, 118 (40.0%) universal approaches, and 2 (0.7%) both approaches\textsuperscript{40,41}. 120 articles (40.7%) were conducted in America, 86 articles (29.1%) were conducted in Europe, 49 (16.6%) were conducted in Australia, 33 articles (11.1%) were conducted in Asia and 7 articles (2.4%) were conducted in Africa. Studies reported (in descending order of frequency) on anxiety features (articles=87, 29.5%), affective symptoms (articles=65, 22.0%), other emotional
and behavioural problems (articles=62, 21.0%), conduct problems (articles=59, 20.0%), general psychological distress (articles=52, 17.6%), alcohol use (articles=42, 14.2%), externalising behaviours, (articles=31, 10.5%), tobacco use (articles=32, 10.8%), internalising behaviours (articles=25, 8.5%), cannabis use (articles=23, 7.8%), ADHD features (articles=21, 7.1%), interpersonal violence (articles=14, 4.7%), eating-related problems (articles=13, 4.4%), consequences of alcohol use (articles=12, 4.1%), PTSD features (articles=6, 2.0%), sleep-related problems (articles=6, 2.0%) and impaired functioning (articles=5, 1.7%) (eTable III). 153 (51.9%) studies reported one of our outcomes of interest, 76 (25.8%) two outcomes, 45 (15.3%) three outcomes, nine (3.1%) four outcomes, nine (3.1%) five outcomes, two (0.7%) six outcomes and one (0.4%) seven outcomes. The interventions provided for the outcomes evaluated were psychoeducation (articles=203, 36.6%), psychotherapy (articles=154, 27.7%), other interventions (articles=96, 17.3%) and combined interventions (articles=102, 18.4%), (eTable IV). The database included 447,206 individuals: 234,330 in the intervention group and 212,876 in the control group. The total sample size (including both intervention and control group) of the studies included ranged from 1342 to 17,32043 individuals (eTable III). The mean age of the sample was 15.4 (SD 7.4), ranging from <144 to 34.345.

Interventions to prevent poor mental health outcomes

Compared to control conditions, universal or selective interventions (Figure 1, Table 3 and eTable IV) improved interpersonal violence (ES=0.431; p=0.021), general psychological distress (ES=0.421; p<0.001), alcohol use (ES=0.401; p<0.001), anxiety features (ES=0.393; p<0.001), affective symptoms (ES=0.304;
p<0.001), other emotional and behavioural problems (ES=0.304; p=0.004), consequences of alcohol use (ES=0.282; p=0.019), PTSD features (ES=0.279; p=0.017), conduct problems (ES=0.210; p=0.021), tobacco use (ES=0.208; p=0.002), externalising behaviours (ES=0.137; p=0.001), ADHD features (ES=0.145; p<0.001 corrected with the trim and fill method to ES=0.132, p<0.001) and cannabis use (ES=0.07; p=0.013).

Conversely, there were no statistically significant differences between the intervention and control condition with respect to eating-related problems (ES=0.147; p=0.589), impaired functioning (ES=0.018; p=0.929), sleep-related problems (ES=0.11; p=0.078) or internalising behaviours (ES=0.084; p=0.018 corrected with the trim and fill method to ES=0.001, p=0.32).

**Effect of specific types of preventive interventions**

There were no statistically significant efficacy differences among psychoeducation, psychotherapy, other types and combined categories of interventions for the prevention of general psychological distress (p=0.054), alcohol use (p=0.631), other emotional and behavioural problems (p=0.082), consequences of alcohol use (p=0.065), PTSD features (p=1.0), conduct problems (p=0.065), tobacco use (p=0.449), externalising behaviours (p=0.260), cannabis use (p=0.551), impaired functioning (p=0.956), internalising behaviours (p=0.735) or sleep-related problems (p=0.212).

However, psychoeducation had the highest effect size for interpersonal violence (ES=0.676, p=0.024), affective symptoms (ES=0.611 p<0.001) and ADHD features (ES=0.202, p=0.004), while psychotherapy had the highest effect size to prevent anxiety features (ES=0.453, p<0.001) according to our meta-analysis.
While differences across specific types of preventive treatments were also found for eating-related problems \((p<0.001)\), there were no statistically significant differences between the intervention and the control condition for all the interventions \((\text{all } p>0.05)\) (eTable IV, Figure 2).

**Universal vs selective preventive interventions**

There were no statistically significant meta-analytic efficacy differences between universal and selective preventive interventions for alcohol use \((p=0.643)\), anxiety features \((p=0.514)\), affective symptoms \((p=0.269)\), other emotional and behavioural problems \((p=0.822)\), conduct problems \((p=0.654)\), tobacco use \((p=0.417)\), ADHD features \((p=0.821)\), cannabis use \((p=0.48)\), eating-related problems \((p=0.672)\), impaired functioning \((p=0.958)\), internalising behaviours \((p=0.456)\) or sleep-related problems \((p=0.166)\).

Universal interventions fared better than selective interventions for interpersonal violence \((\text{ES}=0.575, p=0.046)\), while selective interventions outperformed universal interventions for general psychological distress \((\text{ES}=0.649 p=0.010)\) (eTable V, Figure 3). Selective interventions outperformed universal interventions for externalising behaviours as well \((\text{ES}=0.217 p=0.040)\), but overall interventions were not statistically significant. All interventions to prevent consequences of alcohol use were universal, while all the interventions to prevent PTSD symptoms were selective. Therefore, sensitivity analyses could not be performed.

**Preventive interventions in children and adolescents vs adults**
There were no differences between preventive interventions conducted in children and adolescents and in adults for any of the outcomes evaluated (all p>0.05) (eTable VI).

**Number needed to treat (NNT) and population impact number (PIN) for universal and selective preventive interventions**

The NNT ranged from 18 (95% CI=12-91) for interpersonal violence to 85 (95% CI=49-384) for cannabis use when the CER was set to 10%; it ranged from 10 (95% CI=7-57) for interpersonal violence to 53 (95% CI=30-240) for cannabis use when the CER was set to 20%; and from 8 (95% CI=5-45) for interpersonal violence to 42 (95% CI=24-193) for cannabis use when the CER was set to 30% (eTable VII).

The PIN ranged from 59 (95% CI=41-305) for interpersonal violence to 284 for cannabis use (95% CI=164-1278) for the most conservative scenario (CER= 10% and exposure to the intervention=30%); it ranged from 11 (95% CI=7-64) for interpersonal violence to 60 for cannabis use (95% CI=34-275) for the more liberal scenario (CER= 30% and exposure to the intervention=70%) (eTable VII).

**Quality assessment**

The quality of the clinical trials included ranged from 0;0 (no randomisation, no blinding) in 53 studies (18.0%) to 2;2 in 4 studies (1.4%) (eTable III).

**Heterogeneity, publication bias and meta-regressions**
Heterogeneity ($I^2$) across the included studies was statistically significant ($p<0.001$) and ranged from 57.4% (internalising behaviours) to 98.7% (alcohol use). Publication bias was detected in two of the outcome categories with Egger's test (eTable VIII) and corrected with the trim and fill method. After correction for publication bias, the efficacy of preventive interventions for ADHD features (ES=0.132, CI= 0.0686-0.195, $p<0.001$) was still significant, although the ES decreased; whereas the efficacy of preventive interventions for internalising behaviours (ES=0.00114, CI=-0.073-0.073, $p=0.32$) became statistically non-significant.

Higher study quality was associated with higher efficacy for interventions to prevent impaired functioning ($\beta=0.524$, $p=0.001$), while there were no significant associations with any of the other outcomes ($p>0.05$) (eTable IX).

**DISCUSSION**

To the best of our knowledge, this is the first systematic review to comprehensively address the consistency and magnitude of the efficacy of primary universal and selective prevention in psychiatry. With 295 individual studies, 447,206 young individuals aged less than 35 years, 17 poor mental health outcomes investigated, this is also the largest evidence synthesis in the field. Overall, the study demonstrated that primary universal and selective preventive interventions for poor mental health outcomes in young people are feasible and appear to be effective, although future consolidating research is needed to extend the current evidence base.
This study identified a large literature, confirming the exponential interest in developing and validating universal and selective interventions for mental disorders and providing additional results about some new outcomes which had not been evaluated. Previous meta-analyses have been unable to comprehensively review this literature but selectively focused on specific poor mental health outcomes, such as anxiety or depression\textsuperscript{15,17,18,46}, self-harm and suicidality\textsuperscript{47}, or restricted the analysis to studies conducted in one particular setting (e.g., school\textsuperscript{48} or workplace\textsuperscript{17,49}). One of the meta-analyses focused on a wider range of outcomes - anxiety symptoms, depressive symptoms, hyperactivity, conduct problems, internalising or externalising problems, and general psychological distress\textsuperscript{-}, but again setting was restricted to schools\textsuperscript{48}.

The current study advances knowledge by adopting a broader approach, unrestricted to one single specific poor mental health outcome or setting, thus allowing the global examination of different factors (see below). We demonstrated that, compared to control conditions, universal and selective interventions in young people can lead to improvements in interpersonal violence, general psychological distress, alcohol use, anxiety features, affective symptoms, other emotional and behavioural problems, consequences of alcohol use, PTSD features, conduct problems and tobacco use. The magnitude of the effect sizes of the preventive interventions for these ten outcomes was small. Compared to control conditions, universal and selective interventions in young people can also improve externalising behaviours, ADHD features and cannabis use, but only with a marginal effect. Since universal and selective interventions typically target asymptomatic populations, variance in poor mental health outcomes is expected to be reduced and, consequently, the magnitude
of the effect sizes for these interventions can be expected to be relatively small. The relatively high NNTs and PINs reflect this. For instance, for conduct problems (9/17 regarding ES and NNT out of the outcomes evaluated), the average number of patients receiving the intervention among whom one bad outcome would be prevented would be 19 (95% CI=15-25), assuming a control event rate at the top 20% percentile. This means that if an intervention was incorporated into a primary school with 380 students, conduct problems at the top 20% percentile would be prevented in 20 patients. If 50% of the population of a city with 15 schools and 11,100 primary school students received the intervention in that population, being the PIN 37 (95% CI=30-50), 300 individuals would benefit of the intervention in that population. Since these samples are typically young and not yet affected by psychiatric conditions, small effect sizes (and NNT) can potentially translate into relevant benefits in the longer term, if the intervention is provided to enough individuals. Furthermore, targeting poor mental health outcomes appears to be efficient, particularly alcohol use and depression\textsuperscript{50}. In fact, universal preventive interventions for young people have shown to cost-effective when delivered face-to-face, including school-based psychological interventions\textsuperscript{51}, which together with its efficacy supports the need for its implementation.

According to the presented evidence, eating-related problems, impaired functioning, internalising behaviours and sleep-related problems were not prevented with the available universal or selective preventive approaches. A previous review on preventive interventions for eating disorders found that media literacy was the only universal intervention with some positive effects,
while the selective preventive interventions were heterogeneous in their
efficacy. The evidence thus suggests that there is a particularly high
heterogeneity in the effectiveness of the interventions for eating-related
problems and pooling together some potentially effective interventions as media
literacy with others which are less promising may have resulted in the negative
findings presented. This hypothesis should also be considered for the other
outcomes for which we did not find the preventive interventions to be effective.
Overall, these findings indicate that selective and universal interventions for
young people are feasible and generally consistent in their efficacy, being
unaffected by publication bias (except for internalising behaviours) or study
quality (except for impaired functioning).

Our meta-analysis also provided some insight on the comparative efficacy of
universal vs selective or specific type of intervention categories for preventing
poor mental health outcomes. The highest improvement in ES was observed for
interpersonal violence, with universal interventions being more effective than
selective interventions. Although specific risk factors for interpersonal violence
have been successfully detected, our results suggest that young people in the
general population could benefit from preventive interventions regardless of their
exposure to these risk factors, potentially by improving social competence and
reducing antisocial behaviours. We also found that selective preventive
interventions were more effective than universal interventions for general
psychological distress. A previous meta-analysis confirmed that selectively
targeting maternal distress in vulnerable pregnant women reduces maternal
distress compared to universal approaches, which were not effective. Another
meta-analysis conducted in higher education students found a small effect size\textsuperscript{56}, comparable to the one observed in the current study for universal interventions targeting general psychological distress.

Our results also support similar efficacy of preventive selective and universal interventions for alcohol use and its consequences, both with small effect sizes. Previous meta-analysis showed that preventive family interventions were effective to reduce substance abuse, with a small effect size\textsuperscript{57}, which is comparable to the ES reported by our analysis for the efficacy of other interventions on this outcome\textsuperscript{58}. Preventive interventions for anxiety features and affective symptoms (particularly depression) were the most widely studied outcomes. We showed that preventive universal and selective interventions for anxiety features were equally effective, with a particular high efficacy for psychotherapy, although effect sizes were small. A previous meta-analysis found significant reductions in anxiety symptoms after cognitive behavioural interventions, but effect sizes were small\textsuperscript{59}. Our meta-analysis also showed that preventive interventions for affective symptoms were effective, especially psychoeducation, in line with previous meta-analyses\textsuperscript{21,56,60} (which reported a small ES for universal interventions for affective symptoms\textsuperscript{56}. Our meta-analysis also found that universal and selective interventions are equally effective for the prevention of emotional and behavioural problems, with a smaller ES compared to a previous meta-analysis focusing on preventive parenting programmes for emotional and behavioural problems on children in which this was medium\textsuperscript{61}. According to our results, preventive interventions for PTSD features are effective, although effect sizes are small, both in the general population and in individuals.
with risk factors. A previous meta-analysis found that trauma-focused psychotherapy is effective to prevent PTSD in patients with acute stress symptoms\textsuperscript{62}. We further found equal efficacy of universal and selective interventions for conduct problems, in line with a previous meta-analysis investigating the effect of psychosocial interventions on the prevention of disruptive behaviour problems that also had small effect sizes\textsuperscript{63}. Our meta-analysis also indicate comparable efficacy between universal and selective interventions to prevent tobacco use, extending evidence from a previous meta-analysis showing that preventive interventions can improve this outcome in young individuals\textsuperscript{64}. Marginal ES were detected for other outcomes such as externalising behaviours (for which selective interventions had a higher effect size than universal interventions), ADHD features (for which psychoeducation had the highest effect size in our meta-analysis, in line with NICE guidelines\textsuperscript{65}), and cannabis use. Conversely, there were no statistically significant differences between interventions and controls with respect to eating-related problems, impaired functioning or sleep-related problems. Future research should develop and test innovative interventions for these outcomes. It would also be desirable for this research to try to disentangle in what particular stages of life these interventions would be most effective as well as how the interventions should be delivered and for how long.

Variability in the efficacy of preventive interventions targeting poor mental health outcomes in young people was likely affected by the significant heterogeneity across studies. This review provides guidelines regarding the interventions more likely to successfully prevent poor mental health outcomes. In sensitivity
analyses, we addressed this issue, showing that psychoeducation had the highest effect size for ADHD features, interpersonal violence and affective symptoms. Interestingly, NICE guidelines highlight the need for psychoeducation for individuals with ADHD, while they limit the indications of psychotherapy to particular ADHD cases\textsuperscript{66}. Conversely, preventive selective interventions for externalising behaviours seem more effective for individuals with some risk factors, such as those who experienced stressful life events\textsuperscript{67} or early puberty\textsuperscript{68}. Psychoeducation involves a range of activities that provide information, counselling and supportive interventions. These interventions have been able to increase self-esteem and decrease stigma related behaviours\textsuperscript{69}, improve positive peer relations\textsuperscript{70} and expand the knowledge about psychiatric risk factors and warning signs\textsuperscript{69}. Psychoeducational programs also have the potential to improve family relationships and children's adjustment\textsuperscript{71}. Meanwhile, psychotherapy and particularly CBT-based interventions with young people have the potential to prevent the development of mental conditions\textsuperscript{72} by different mechanisms including the reduction of the use of avoidance coping skills and an increase in the levels of problem-solving coping skills\textsuperscript{73}. Regarding other and combined interventions, parent training, targeting both family interactions and social network support\textsuperscript{2,74} could reduce aggressive behaviours and violence\textsuperscript{72} and help develop positive behaviours\textsuperscript{72}. Other interventions such as physical therapy\textsuperscript{75}, animal-assisted therapy\textsuperscript{76} and art therapy\textsuperscript{77} have different mechanisms. Finally, our meta-regressions only found an association between higher study quality and increased efficacy of preventive interventions for impaired functioning.
This study has several limitations. Firstly, there was limited amount of evidence for some of the poor mental health outcomes, particularly sleep-related problems, impaired functioning, eating-related problems and interpersonal violence. However, the database was large and sufficiently powered to test the preventive efficacy for most outcomes. Secondly, we were unable to quantify the differential efficacy of specific interventions pooled in the "other" interventions and "combined" interventions subgroups. We also could not provide evidence-based recommendations of specific interventions within psychotherapy and psychoeducation. Although cognitive behavioural therapy was the most frequently investigated psychotherapy, other interventions included acceptance and commitment training or interpersonal therapy. Third, quality for most of the studies was low, with no blinding and/or randomisation. However, we found no association between study quality and efficacy in meta-regression analyses, except for impaired functioning. Also, the quality assessment procedure employed in the current protocol may have been suboptimal compared to currently recommended methods. However, this approach was decided a priori in the study protocol to fully meet the characteristics of the evidence reviewed and the expected large number of studies to be extracted and screened. Fourthly, due to study heterogeneity, we were also unable to investigate other potentially important modifiers of treatment response. Fifthly, there was very limited evidence on preventive approaches for categorical mental disorders other than psychosis. This was likely due to the fact that prevention of mental disorders is more established through indicated as opposed to universal or selective approaches. Efficacy of selective and universal approaches for preventing categorical ICD/DSM disorders remain unknown. Sixthly, it was not possible to
ascertain the long-term efficacy of the interventions, only the post-test efficacy and other implementation factors related to this. We also did not address systematically the financial and social benefits of preventive interventions. Finally, the outcomes analysed by the current review were pragmatically aligned with the operationalisation provided by each individual study. Consequently, the accuracy of these categorical outcomes relied on their definition provided by each individual study.

**CONCLUSIONS**

Selective and universal preventive interventions for young individuals are feasible and can improve poor mental health outcomes. Psychoeducation for ADHD features, affective symptoms and interpersonal violence, and psychotherapy for anxiety features are particularly promising. Future research should consolidate these findings to further inform preventive interventions.
REFERENCES


