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ORIGINAL ARTICLE

Do School-Level Anti-Bullying Interventions Affect Prescriptions of Prescribed Drugs in Young Adulthood? A Case Using the Olweus Bullying Prevention Program

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Abstract

Several meta-analyses have demonstrated that bullying prevention programs are successful in reducing bullying. However, scant research addresses if and how such anti-bullying efforts affect long-term internalizing health problems and even less on later use of pharmacotherapy and psychotherapy. This study explores how the school-based Olweus Bullying Prevention Program (OBPP) affects the likelihood of being prescribed antidepressant drugs, anxiolytics, hypnotics, and sedatives, using a difference-in-difference design with population-wide Norwegian register data, including the Norwegian Prescription Database. Generally, we find that student cohorts from schools with a higher proportion of victimized students have more prescribed drugs at ages 17–22. Although OBPP substantially reduces victimization, and, hence, assumedly internalizing problems, our results indicate that the OBPP increased the likelihood of being prescribed drugs for internalizing problems between ages 17 and 19. Our interpretation of these findings is that the OBPP had increased awareness of bullying in school and its damaging consequences, and thereby reduced the mental and attitudinal barriers that often prevent students from seeking help for internalizing problems. It should be noted, however, that the victimization data in our study were linked to schools only and not to register data for individual students. Accordingly, we were restricted to studying average program effects at the school level. The power to detect long-term effects would have been better with student-linked data for both the victimization and register variables.

Keywords Bullying prevention programs · Olweus · OBPP · Students' mental health · Internalization problems · Prescription drugs

Being bullied in school is associated with, and likely a direct cause of, internalizing problems such as depression, anxiety, suicidal thoughts/behavior, and psychosomatic problems (e.g., sleep problems, headaches, stomach pains), which persist for years after the bullying occurred (Arseneault, 2018; Gini & Pozzoli, 2013; Holt et al., 2015; Olweus & Breivik, 2014; Ttofi et al., 2011b). The severe consequences of mental health problems on victims' lives and the high societal costs of incapacitating problems have generated substantial demand for preventive interventions (Smith, 2019).

Dan Olweus died before publication of this work was completed.

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Some of these interventions have successfully reduced bullying, which has led some to suggest that anti-bullying programs can be considered early interventions for public health (Gaffney et al., 2019a, b; Menesini & Salmivalli, 2017).

Although the effects of anti-bullying programs on the primary variables of bullying victimization and perpetration are well known (Gaffney et al., 2019a, b; Smith, 2019), evaluations of such programs have sparsely studied secondary effects on mental health and then only in the short term (Fekkes et al., 2006; Juvonen et al., 2016; Williford et al., 2012). We are not aware of any studies investigating the long-term mental health effects of bullying prevention programs. Thus, this paper addresses a gap in the literature by examining selected long-term mental health effects for students exposed to the Olweus Bullying Prevention Program (OBPP). Using a difference-in-difference (DiD) design, we investigate whether attending an elementary OBPP school affects the students' use of the prescribed pharmacotherapeutic drugs such as antidepressants, anxiolytics, and sedatives as young adults (ages 17–19) in Norway.

There is scant research on the association between bullying victimization and the later use of pharmacotherapy and psychotherapy (Sourander et al., 2007). With this background, we assume in brief two different ways in which OBPP may affect prescription drugs. On the one hand, reducing the proportion of victimized students can be expected to result in fewer internalizing problems, which subsequently may reduce the use of prescription drugs. On the other hand, OBPP may increase the use of prescribed drugs. A sizeable proportion of victimized students have persistent "mental scars" or post-traumatic stress symptoms from bullying over an extended period (Nielsen et al., 2015; Olweus & Breivik, 2014; Sjursø et al., 2020). By increasing the awareness of bullying in schools and its damaging consequences, students may feel more comfortable seeking help, and school staff may be more able to help these victims. Furthermore, with increasing maturation and understanding, students may gradually realize they need professional help to tackle the problems that continue to affect their daily lives. As there are mental and attitudinal barriers that prevent adolescents from seeking help for mental health problems, and only a few seek or get such help (Gulliver et al., 2010), increased use of prescription drugs could be seen as a favorable outcome of the program.

Our point of departure is that, unlike many anti-bullying programs with minimal impact on bullying, programs inspired by the work of Dan Olweus, and especially the OBPP, have been highlighted to be effective at reducing bullying (Ttofi & Farrington, 2011). Thus, OBPP in Norway provides a good case to examine if and how an anti-bullying program may affect pharmacotherapy. As part of the general intervention strategy of the OBPP, however, individual bullies and victims are not identified in the data (we only have anonymous student reports on bullying). Thus, we cannot study the long-term effects of bullying prevention for identified victims and bullies in this study. Instead, we are restricted to studying average intervention effects across all students, which we call population-level program effects.

The Effectiveness of the Olweus Bullying Prevention Program

Bullying is defined as a subset of aggressive behavior carried out by a group or an individual, and it is characterized by intentionality, repetitiveness, and a power imbalance between perpetrator(s) and victim (Olweus, 1993, 2013). The prevalence of bullying varies widely by definition, measurement, age group, and country (Craig et al., 2009). Some large-scale cross-national studies indicate that about 4–9% of school-age children frequently engage in bullying, while 9–25% of school-age children from western countries report being bullied. The prevalence might be considerably higher in certain other non-western countries (Menesini & Salmivalli, 2017).

Whereas bullying was once considered a normative behavior of childhood (Silberg & Kendler, 2017), it is now recognized as a major problem with severe implications for children who are bullies and/or victims (Olweus, 1993, 2013; Swearer, Espelage, Vaillancourt, & Hymel, 2010). The first systematic, research-based effort to prevent bullying in schools dated back to 1983 and was later known as the Olweus Bullying Prevention Program (OBPP) (Olweus, 1991, 1993, 2013). While many different bullying prevention programs have been developed since then (Smith, 2019), the OBPP remains one of the most researched (Limber et al., 2018; Olweus et al., In press), and probably one of the most effective at reducing bullying (Ttofi & Farrington, 2011).

In a recent, comprehensive meta-analysis updating the Ttofi and Farrington analyses (Farrington & Ttofi, 2009; Ttofi & Farrington, 2009, 2011), Gaffney et al. (2019a, b) estimated that while the variability of program effects is considerable, on average, anti-bullying programs tend to decrease bullying perpetration and bullying victimization by about 20 and 15%, respectively. No randomized controlled trial of the OBPP has been conducted. However, the OBPP has been shown in several replicated large-scale studies to reduce bullying problems by about 30–50% in elementary schools after eight months of implementation in Norway (Olweus & Limber, 2010, 2019), with somewhat weaker effects in the USA (Limber et al., 2018; Sullivan et al., 2021) and Germany (Ossa et al., 2021). Studies have shown that schools successfully implementing the core program components (classroom rules against bullying, use of role-playing, and classroom meetings) experience greater reductions in bullying problems (Olweus & Limber, 2010). Moreover,

program effects gradually decline over time for schools that drop out of the program, while schools that continue using the OBPP seem to maintain the initial program effect (Olweus et al., 2020).

The OBPP is a whole-school or universal anti-bullying program with targeted components designed to reduce the prevalence of existing bullying problems, prevent the development of new problems, improve peer relations at the school, and build a sense of community (Olweus, 2013; Olweus et al., In press; Olweus & Limber, 2007, 2010). The OBPP is built on principles derived from an authoritative conceptual framework which have been translated into a number of coordinated components, implemented at the school, classroom, individual, and (in the USA in particular) community levels. School personnel work to restructure schools' social environment to reduce opportunities and rewards for bullying and build a sense of community (Olweus & Limber, 2010).

Potential Effects of Anti-Bullying Prevention Programs on Pharmacotherapy

Generally, evaluations of bullying prevention programs have focused on the main objective of reducing bullying and creating a safe school environment and only sparsely studied secondary prevention effects. Thus, the expected long-term effects of bullying prevention programs are primarily derived from research that demonstrates the effectiveness of bullying prevention efforts on bullying (discussed above) and independent research that shows that bullying has long-term consequences on mental health problems (Arseneault, 2018; Hawker & Boulton, 2000; Schoeler et al., 2018; Ttofi et al., 2011a). We are aware of no studies that have examined the effects of bullying prevention programs on pharmacotherapy (i.e., treatment of a disorder or disease with medication).

As noted above, one way that bullying prevention programs may affect the use of prescription drugs is by reducing victimizations and associated internalizing problems. Only a few studies have examined whether bullying prevention programs have reduced internalizing problems. Studies of the KiVa program in Finland, the Netherlands, and Italy have indicated some weak and somewhat inconsistent secondary, short-term effects on self-reported depression, self-esteem, and anxiety (Huitsing et al., 2019; Juvonen et al., 2016; Nocentini et al., 2018; Williford et al., 2012). Furthermore, in an early study in the Netherlands on a bullying prevention program inspired by OBPP, there was a non-significant trend of fewer depressive symptoms after a year and no effects on psychosomatic complaints (Fekkes et al., 2006). A recent Italian study found, however, that the NonTrap! anti-bullying program significantly reduced internalizing problems (Palladino et al., 2019). In sum, the limited available evidence indicates that there might be some secondary effects of anti-bullying programs on internalizing problems, at least in the short term.

Moreover, even if bullying prevention programs reduce internalizing problems, it is unlikely that this reduction translates into a sizeable effect on pharmacotherapy. Based on a systematic review of the evidence, Moore et al. (2017) did not find any consistent increase in the utilization of health services or medications in those exposed to bullying victimization during childhood or adolescence. A possible explanation for this is that relatively few young people with mental health problems seek professional health (Gulliver et al., 2010). For example, one Norwegian survey found that among the 15–16-year-olds with the highest percentile on self-reported anxiety and depression, only 34% had sought help from health care providers during the last 12 months (Zachrisson et al., 2006).

Furthermore, even when young people receive a psychiatric diagnosis, pharmacotherapy is seldom the first treatment of choice. For young individuals, treatment guidelines typically recommend using medication only when the effect of evidence-based psychotherapy has been sub-optimal (Ask et al., 2019). In Norway, less than 30% of adolescents between 13 and 17 years with incidence anxiety or depression diagnoses were treated with antidepressants/anti-anxiety drugs within 6–12 months after being diagnosed (Ask et al., 2019; Skurtveit et al., 2018).

Low utilization of health services among youth who have experienced bullying victimization points to another channel in which bullying prevention programs may affect pharmacotherapy. One effect of bullying prevention programs such as OBPP is to increase the awareness among students and school staff of bullying and its severe consequences, which may, in turn, increase the likelihood of victims getting the help they need. Having been bullied for several years, as is the case for many victimized students, some proportion of them have likely developed persistent "mental scars" and may need long-term professional help (Fisher et al., 2012). With increased maturation and understanding of the consequences of bullying and contact with health personnel in school or caring teachers, some victimized students may gradually realize they need professional help to overcome bullying consequences.

Concerning the relative strength of the two main mechanisms, the effects of bullying prevention efforts on health care utilization may be larger than the effects on drug prescription because of less internalizing problems. To begin, positive effects on health care utilization may apply equally to both earlier victimized students who escape bullying and those who remain victims even after program implementation. In contrast, effects operating through less internalizing problems are caused mainly by the group that would have been bullied in the absence of the program.

The Norwegian context studied in this paper can be used to illustrate how health care utilization effects may exceed effects via less internalizing problems. In the present context, about 12% of the 5–7th graders in OBPP schools reported being bullied before the implementation, with the intervention reducing bullying by 30–50% after 8 months of work with the program (Olweus & Limber, 2010, 2019; Olweus et al., 2020). Nevertheless, these substantial reductions translate into an absolute change in the proportion of victims among all students of "only" about 3–4 percentage points. Ignoring bystander effects (Rivers et al., 2009) and effects that operate via a better learning environment, this means that effects operating through more health care utilization are driven by 12% of the student population. In contrast, effects operating through internalizing problems are driven "only" by the 3–4% that escapes bullying because of OBPP. Additionally, positive effects on health care utilization could arise irrespective of whether bullying victimization causally affects internalizing problems (Arseneault, 2018; Singham et al., 2017). In contrast, the effects of bullying prevention on prescriptions operating via less internalizing problems are caused by the causal effect of bullying on internalizing problems (for those who escape bullying because of the program).

Methods

Study Setting

Our primary data source is the population-wide Norwegian register data, covering all students born between 1980 and 1999 who attend an elementary school (grades 1–7), excluding children of immigrants who arrive in Norway after school starting age. Compulsory education in Norway starts at the age of six and lasts for 10 years, with primary education in grades 1 to 7 and lower secondary education in grades 8 to 10. Few students receive compulsory education in private schools (about 4%), and all schools are publicly funded. There are three main types of schools in Norway: elementary school (grades 1–7), lower secondary school (grades 8–10), and combined primary and lower secondary schools (grades 1–10). The target population in the current project is elementary schools, in which bullying and mental health problems have been subject to policy concern. In Norwegian elementary schools, 15–20% of students have health problems such as anxiety, depression, and behavioral problems that affect their daily life (Stoltenberg, 2014), and 6–8% of students report they are regularly being bullied by peers (Wendelborg, 2020).

The national register data does not include information about school programs. However, data on OBPP schools were combined with the register data via a unique school identifier. The data used for the analyses contain 1483 control and 224 program elementary schools. The program schools represent six different cohorts beginning implementation at half-year intervals, with 36 elementary schools starting implementation in fall 2001, 31 schools in spring 2002, 39 schools in fall 2002, 85 schools in spring 2003, 10 schools in fall 2003, and finally 23 schools in spring 2004 (Appendix Table B1).[1]

Data on programs or school practices in the control schools were unavailable in the current study, nor were data available on program implementation in lower secondary schools (grades 8–10) or upper secondary schools. About 60% of elementary schools reported in 2010 that they actively implemented a school program to reduce behavioral problems and improve the learning environment, meaning that many control schools are likely implementing other interventions and programs such as School-Wide Positive Behavioral Interventions and Supports, Second Step, Connect, and Aggression Replacement Training (Borgen et al., 2021a, b; Vibe, 2010). Thus, the estimated effects of OBPP reflect observed outcomes compared to the outcomes one would have expected in the absence of OBPP, including that the program and control schools may initiate other programs or act differently in other ways.

Measures

The treatment indicator tracks the position of each school grade cohort relative to the year of program implementation, from 4 years before the program implementation to 4 years after. The treatment variable has nine unique values (−4, −3, −2, −1, 1, 2, 3, 4, 99), and we construct seven dummy-coded variables (−1 as reference category and 99 is excluded). Students are labeled −1 if they finished elementary school either the same spring as the baseline was completed or if the baseline was completed in the following fall. The next cohort, exposed to OBPP for either the entire 7th grade (if baseline during the spring semester) or the spring semester of 7th grade (if baseline during the fall semester), is labeled 1. The cohort labeled 4 is the first cohort potentially exposed to the program through grades 4–7. Since exposure equals time since implementation, any differential effects across cohorts will capture the combined impact of length of exposure for the individual and length of implementation at the school. The control schools are assigned the arbitrary value

[1] The fall semester runs from August to December and the spring semester from January to June.

99 for all school cohorts. Since there is no within-school variation in the treatment variable for control schools (see analytic design below), the coefficient for control schools is not estimated.

Information on prescription drugs is based on data from the Norwegian Prescription Database (NorPD), a national health register that monitors all drugs dispensed by prescription in Norway since 2004.[2] There are both advantages and disadvantages of using prescription drugs to proxy for mental health problems compared to clinical or self-reported information on internalizing problems. The main advantages of using prescription drugs are that they are accurately reported and observed for all students throughout adolescence and early adulthood without any attrition. However, interpreted as proxies for mental health problems, prescription drugs have several limitations; especially at a young age, a low proportion of students with internalizing problems receive pharmacotherapy (Gulliver et al., 2010), and among those who receive prescription drugs, not all have internalizing problems. In Norway in 2010–2014, about 25% of 13–17-year-olds with incident diagnoses of depressive disorders were treated with antidepressants, while only 50–65% of 13–17-year-olds who receive antidepressants were diagnosed with anxiety or depression problems (Skurtveit et al., 2018).

Drugs in NorPD are classified according to the World Health Organization Anatomical Therapeutic Chemical (ATC) classification system. Our study focuses on psycholeptic drugs (N05) and psychoanaleptic drugs (N06) within ATC group N (nervous system). Based on level 3 and level 4 of the ATC classification system, we define three groups of drugs: (1) antidepressants (N06A), (2) anxiolytics (N05B), and (3) hypnotics and sedatives (N05C). Antidepressants comprise preparations used in the treatment of endogenous and exogenous depression as well as anxiety. Anxiolytics comprise preparations used to treat neuroses and psychosomatic disorders associated with anxiety and tension, including certain benzodiazepines. Finally, hypnotics and sedatives comprise preparations with mainly sedative or hypnotic actions, including z-hypnotics and melatonin receptor agonists.

In addition to these three distinct groups of drugs, we combine all three in one group, which we call internalizing drugs. There is no one-to-one relationship between a specific prescription drug and a diagnosis or problem (Skurtveit et al., 2018; Wong et al., 2016). For example, while selective serotonin reuptake inhibitors (SSRIs) are classified within the ATC classification system as antidepressants, they are also the preferred drug for treating pediatric anxiety disorders (Ask et al., 2019; Wesselhoeft et al., 2020). Thus, we will refer to antidepressants, anxiolytics, hypnotics, and sedatives broadly as medication against internalizing problems.

In the main analyses, we measure whether students have received one or more prescriptions of these groups of licit drugs during the calendar year they turn 17 to the calendar year they turn 22 (recorded as 1 if a drug, 0 otherwise). Additionally, we examine whether the effects are different in the early part of the observation period (ages 17–19) compared to later (ages 20–22). There is a tradeoff between several different factors when defining the outcome age interval. As few studies track students after they have left program schools, we do not know whether the intervention effects diminish, persist, or even increase with time. Nevertheless, it is generally assumed that program effects diminish over time, suggesting that we should study effects as soon as possible after program exposure ends (age 13) and subsequently see whether these effects persist.

Although we can observe prescription before and after program exposure for a small proportion of students as early as age 13, we have only full coverage of all students attending program schools from age 19 (Appendix Table B2). From age 17, we can observe 80% of the students before the program is introduced and all students exposed to it. Furthermore, when using prescriptions to study mental health problems, a challenge is that youth are rarely treated with medications before late teens (Fig. 1), as psychotherapy is the preferred treatment choice. Thus, although we expect that bullying around age 13 has larger effects on mental health problems at ages 14–16 compared to later, this may not show up in prescriptions of internalizing drugs.

Individual control variables are year of birth (dummies), gender, parents' earnings at ages 11–15 in percentile rank (linear and quadratic term), father's educational level (9 dummies), mother's educational level (9 dummies), immigrant background (dummies), number of siblings (linear and quadratic term), birth order (linear and quadratic term), father's year of birth (linear and quadratic term), mother's year of birth (linear and quadratic term), and parents social welfare recipients (number of years when the child is 0–15 years). Descriptive statistics for drug use, OBPP exposure, and controls can be found in Table 1.

Linking Students to Schools in Register Data

Norway does not maintain a registry of the primary school students attend. Therefore, we impute school attendance from residential addresses, as detailed in Appendix A. This imputation will cause some misclassification of the school attended, and thus of program exposure: some students

[2] Drugs purchased without prescription (over the counter) or supplied to hospitals and nursing homes are not included. Filled prescriptions does not equate drug use since not all dispensed drugs are consumed; however, this is less of a concern in this paper because we are mainly interested in these prescriptions as proxies for underlying mental health problems rather than drug use as such

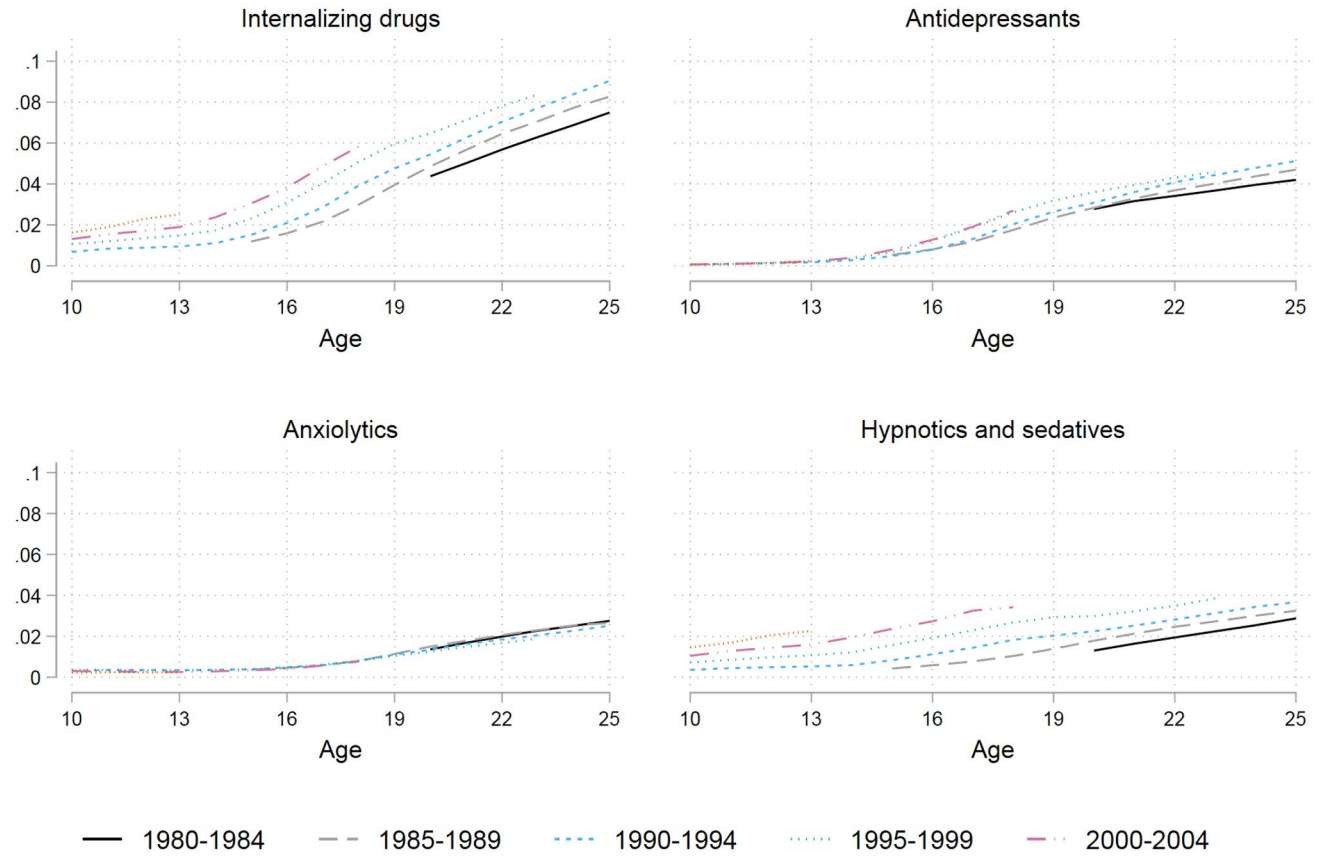

Fig. 1 Drug use by age and birth cohort of students

will be incorrectly classified as exposed or not exposed to the program. This type of misclassification could bias the effect estimates either upwards or downwards; however, the misclassification in this study will probably cause a slight attenuation bias in the effect estimates and a loss in statistical power. Assuming it is conditionally random, we argue in Appendix A that misclassification attenuates the effect estimates by a factor of about 0.9 and that we can inflate coefficients and standard errors by about 11% (1/0.9=1.11) to adjust for the attenuation bias (although it does not address the problem of loss in statistical power). As this adjustment is relatively minor, we will not explicitly implement this adjustment as part of our estimator but refer to it in our discussion of the results.

The Analytic Approach to Study the Long-Term Effects of OBPP

Schools were not randomly assigned the OBPP intervention but chose themselves to implement the program. This self-selection implies that we cannot directly compare students from program and control schools because schools implementing a program like OBPP may differ from other schools (e.g., higher levels of bullying, more attentive school staff, and leadership). Our strategy is to compare outcomes of different birth cohorts *within the same school* and estimate a difference-in-difference (DiD) model that accounts for selection into treatment as well as time/cohort effects common to all schools. The DiD model compares outcomes between subsequent cohorts of students within schools after accounting for observable student characteristics. The purpose of the control schools is to adjust for factors (calendar time and cohort) that are shared by all students in the same grade. The main advantage of DiD is that it accounts for all time-invariant differences between schools, such as stable school, teacher, and student characteristics, irrespective of proxies for these differences (Angrist & Pischke, 2009).

The unit of observation is the student, and the basic model is:

$$Y_{ics} = \beta_0 + \beta T_{cs} + \delta X_{ics} + \gamma_c + \mu_s + \varepsilon_{ics} \quad (1)$$

Y_{ics} is the outcome (e.g., prescribed antidepressant drugs) of student i belonging to cohort c that attended school s. β_0 is a constant term, T_{cs} indicates whether a given cohort in a given school was enrolled after the implementation of OBPP ($T_{cs} = 1$), γ_c is dummy variables for birth cohort (i.e., birth

Table 1 Descriptive statistics of the sample used to estimate the effects of OBPP

	N	Mean	SD	Min	Max
Internalizing drugs (17–22)	451,895	0.150	0.357	0	1
Internalizing drugs (17–19)	576,492	0.079	0.270	0	1
Internalizing drugs (20–22)	560,968	0.114	0.318	0	1
Antidepressants (17–22)	451,895	0.084	0.277	0	1
Antidepressants (17–19)	576,492	0.041	0.199	0	1
Antidepressants (20–22)	560,968	0.065	0.246	0	1
Anxiolytics (age 17–22)	451,895	0.050	0.217	0	1
Anxiolytics (age 17–19)	576,492	0.020	0.140	0	1
Anxiolytics (age 20–22)	560,968	0.037	0.189	0	1
Hypnotics and sedatives (age 17–22)	451,895	0.076	0.266	0	1
Hypnotics and sedatives (age 17–19)	576,492	0.041	0.198	0	1
Hypnotics and sedatives (age 20–22)	560,968	0.052	0.222	0	1
Before/after OBPP					
Prior to implementation (−4 to −1)	685,565	0.036	0.187	0	1
Exposed for 1 year	685,565	0.010	0.100	0	1
Exposed for 2 years	685,565	0.010	0.101	0	1
Exposed for 3 years	685,565	0.010	0.100	0	1
Exposed for 4 years	685,565	0.010	0.100	0	1
Control schools	685,565	0.923	0.267	0	1
Year of birth	685,565	1991.616	4.445	1984	1999
Girl	685,565	0.486	0.500	0	1
Immigrant background					
Non-immigrant	685,565	0.945	0.227	0	1
Immigrant	685,565	0.011	0.103	0	1
Children of two immigrants	685,565	0.044	0.205	0	1
Age of immigration	685,565	0.050	0.472	0	6
Parental earnings rank	684,134	49.971	29.233	1	99
Father's education	653,428	4.254	1.714	0	9
Mother's education	659,428	4.213	1.726	0	9
Parents social welfare	684,136	0.383	1.196	0	6
Father's year of birth	674,421	1960.315	6.922	1915	1983
Mother's year of birth	682,771	1963.235	6.254	1933	1984
Birth order	685,527	1.884	0.999	0	14
Number of siblings	684,136	1.991	1.256	0	18

cohort fixed effect), μ_s is dummy variables for schools (i.e., school fixed effect), and X_{ics} are observed student characteristics variables (female, fathers' and mothers' education and earnings, immigrant background). Cohort refers to the year a student exits primary school (and exposure to OBPP ends). ε_{ics} is a residual, capturing unexplained variation in results at the student level.

The key identifying assumption is that the evolution of drug use over time would be parallel for both OBPP schools and control schools in the *absence* of the OBPP intervention (net of the effects of changes in observed student characteristics). If this common trend assumption does not hold, and there are systematic differences in trends between program and control schools, then the effect estimates will be biased.

The common trend assumption is untestable, but we can indirectly evaluate its credibility by comparing trends for program and non-program schools prior to implementation. If the assumption of common trends holds, we should expect a stable difference between the program and the control schools *before* the implementation (net of differences explained by time-varying covariates and general time trends). During the pre-program years, we expect no (significant) differences between cohorts within the same school. In Appendix Figure B1, we estimate the OBPP coefficient before and after implementation:

$$Y_{ics} = \beta_0 + \sum_{p=-4}^{4} \beta_p T_{csp} + \delta X_{ics} + \gamma_c + \mu_s + \varepsilon_{ics} \quad (2)$$

where β_p parameters identify any pre-program differentials ($p<0$) and post-implementation effects ($p>0$) as $T_{csp} = 1$ when the outcome of the cohort is measured *with a time distance of p years* since the implementation of the program. β_{-1} is set equal to 0 and provides a reference for the effect estimates for the other years. For example, β_2 measures the effect on Y for students exiting primary school 2 years after the implementation of OBPP relative to the outcomes of students exiting primary school just before implementation, i.e., the effect of being exposed to OBPP for two years (grades 6–7). The credibility of the common trend assumption is tested by examining if there are no differences between cohorts within the same school before the implementation, i.e., $\beta_p = 0$ for $p<0$ (net of differences explained by time-varying covariates and general time trends).

The results in Appendix Figure B1 suggest that the assumption of common trends holds and consequently that the effect estimates are valid. Thus, in the main analyses, we opt for a more stripped-down DiD model where we estimate the effects of OBPP in years since the implementation of the program relative to the (average of the) pre-intervention years:

$$Y_{ics} = \beta_0 + \sum_{p=1}^{4} \beta_p T_{csp} + \delta X_{ics} + \gamma_c + \mu_s + \varepsilon_{ics} \quad (3)$$

Although we have binary outcomes, ordinary least squares is preferred over logistic regression or probit because of the problem of unobserved heterogeneity, and in order to ease interpretation of the estimates (Mood, 2010); however, results using unconditional fixed effects logistic regression is nearly identical to the main findings (Appendix Figure B7). Students i are nested within cohort c within schools s and there is a concern that unobserved characteristics or shocks make the residuals ε correlated within schools. We cluster standard errors at the unit of the fixed effect (overall school level) in all analyses to adjust for these correlations (Cameron & Miller, 2015).We have used Stata 16.0 to run all analyses.

Results

Associations Between School-Level Bullying and Later Drug Use

As noted, one reason that OBPP may affect prescription drugs is via fewer students involved in bullying. In that case, the effects of OBPP will mainly depend on the change in the number of victims multiplied by the long-term consequences of being a victim of prescription drugs. For recent cohorts, the Annual National Pupil Surveys of all 7th graders in Norway provide anonymous student-based data describing the proportion of victims, aggregated to the school level.

Associations between bullying and school-level prescribed drugs are not identical to corresponding associations

Table 2 Association between the proportions of students being bullied in the 7th-grade school-cohort and school-cohort-level prescription drugs

	Internalizing drugs		**Antidepressants**		**Anxiolytics**		**Hypnotics and sedatives**	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: age 17–22								
Bullying victimization	0.0844***	0.0669***	0.0463***	0.0420**	0.0410***	0.0283*	0.0454***	0.0301*
	(0.0154)	(0.0176)	(0.0122)	(0.0149)	(0.0085)	(0.0115)	(0.0120)	(0.0148)
N	6152	6152	6152	6152	6152	6152	6152	6152
Panel B: age 17–19								
Bullying victimization	0.0390***	0.0298**	0.0196**	0.0109	0.0168***	0.0090*	0.0171**	0.0181*
	(0.0088)	(0.0093)	(0.0065)	(0.0070)	(0.0038)	(0.0044)	(0.0065)	(0.0071)
N	12,283	12,283	12,283	12,283	12,283	12,283	12,283	12,283
Panel C: age 20–22								
Bullying victimization	0.0627***	0.0379*	0.0375***	0.0373**	0.0262***	0.0172+	0.0291**	0.0103
	(0.0137)	(0.0160)	(0.0104)	(0.0134)	(0.0070)	(0.0095)	(0.0101)	(0.0126)
N	6152	6152	6152	6152	6152	6152	6152	6152
Individual control variables	No	Yes	No	Yes	No	Yes	No	Yes
School fixed effects	No	Yes	No	Yes	No	Yes	No	Yes

Standard errors clustered at the school level in parentheses. The included school cohorts are in grade 7 in the school years 2006/2007 to 2014/2015. Observations are averages at the school-cohort level, and we included analytical weights (number of students in the school cohort) to account for heteroscedasticity due to different school sizes. Bullying victimization is defined as the share of the school cohort during 7th grade that reports being bullied at least 2–3 times a month. In 7th grade, the share bullied is 7.7%. Results in columns 1, 3, 5, and 7 are estimated using the regress command, while results in columns 2, 4, 6, and 8 are estimated using the areg command to capture the school fixed effects. All in Stata 16.0

$^{+}p < 0.10$, $^{*}p < 0.05$, $^{**}p < 0.01$, $^{***}p < 0.001$

at the individual level. Even if consequences for victims mainly cause the school-level associations, these associations also capture potential externalities such as improvement in the learning environment for students not directly involved in bullying and adverse effects of observing bullying for bystanders (Rivers et al., 2009). School-level associations may also differ from individual-level associations for other reasons. Because fewer victims typically mean less perpetration (i.e., the correlation between school-level bullying victimization and school-level bullying perpetration of 0.36), the estimated associations between bullying victimization and drug prescriptions at the school level also capture potential effects of bullying perpetration.

In our sample of schools, 7.7% of 7th-grade students were bullied in the cohorts 2007–2015. As expected, student cohorts in schools with a higher proportion of 7th graders being bullied have more prescribed drugs at ages 17–22 (Table 2). Focusing on at least one prescription between ages 17 and 22 (Panel A), the bivariate associations without control variables (columns 1, 3, 5, and 7) suggest that an increase in bullying victimization at the school level by five percentage points raises prescribed internalizing drugs of the same students by 0.42 percentage points (0.0844*0.05), antidepressants by 0.23 percentage points (0.0463*0.05), anxiolytics by 0.21 percentage points (0.0410*0.05), and hypnotics and sedatives by 0.23 percentage points (0.0454*0.05). These bivariate associations are stronger at ages 20–22 (Panel C) than at ages 17–19 (Panel A), reflecting the fact that the likelihood of being treated with medications is lower at a younger age, irrespective of the degree of internalizing problems.

Bivariate associations between bullying and long-term individual outcomes are likely confounded, whether measured at the individual or the school level (as here). To get closer to a causal effect of bullying involvement, we compare subsequent school cohorts within the same school (school fixed effects) after netting out the effects of individual control variables (columns 2, 4, 5, and 8). Focusing on the outcome of at least one prescription between ages 17 and 22 (Panel A), the controls reduce the association between victimization and internalizing drugs by 20% (the unstandardized coefficient). Likewise, the associations between victimization and antidepressants, anxiolytics, and hypnotics and sedatives are reduced by 10 to 30%. Although we are reluctant to interpret even these conditional within-school associations as causal effects of school-level bullying, the estimates are informative as upper-bound estimates of the long-term effects of victimization and perpetration at the school level.

Even the upper-bound, maximum-effect estimates in Table 2 are relatively limited. They suggest that reducing bullying likely has small population-level effects on prescribed drugs, especially at a young age.

Effects of the OBPP

OBPP may increase the likelihood of getting prescription drugs via more health care utilization *and* decrease the likelihood via less internalizing problems. Of these two mechanisms, the estimates in Table 2 provide useful input to the expected size of program effects that operate through less internalizing problems. Because the estimates serve as illustrative maximal population-level outcome effects of decreasing bullying victimization by a given percentage point, we can multiply them with the OBPP effects (Olweus & Limber, 2010) to benchmark the program effect on the long-term outcomes expected to operate through less internalizing problems. Considering this mechanism in isolation, the OBPP reduces prescribed internalizing drugs by 0.27 percentage points (0.0669*−.04) since (i) the program reduces victimization by four percentage points (−0.04) and (ii) the effect of school-level victimization from none to all is 0.0669.[3] By similar logic, we expect that the OBPP at best would reduce prescribed antidepressants, anxiolytics, and hypnotics and sedatives by 0.17, 0.11, and 0.12, respectively. These numbers show that the program potential for reducing prescriptions for mental health problems at the *population level* is minimal.

Program effects of OBPP on individual student outcomes are presented in Table 3 and in Fig. 2 (ages 17–22) and Fig. 3 (ages 17–19 and ages 20–22). The estimates are all from separate DiD models, comparing cohorts within the same school. At ages 17–22, none of the coefficients are statistically significant at the 10% level or lower. Nevertheless, the coefficients are mostly positive, indicating that OBPP is more likely to increase than to decrease the likelihood of getting at least one prescription between ages 17 and 22. The same pattern, only stronger, emerges when looking at the number of years with prescriptions between ages 17 and 22 (Appendix Figure B3).

However, program effects seem to be larger when students are in their late teens (ages 17–19) compared to their early 20s (ages 20–22). Whereas program effects are closer to zero among 20- to 22-year-olds, there seems to be a significant positive effect of OBPP on the likelihood of being prescribed internalizing drugs between 17 and 19. Looking at average program effects across 1–4 years of exposure, we find that OBPP increases the overall likelihood of being prescribed internalizing drugs by 0.5 percentage points. Adjusting the effect estimates for misclassification (cf. our previous discussion on linking students to schools) increases the effect estimate to 0.56 percentage points (.005*1.11).

[3] This calculation of potential population-level effects of OBPP assumes that the relationship between bullying and prescription drugs is equal between Olweus schools and the control schools; as discussed below, we do not believe that this assumption holds.

Table 3 Effect estimates and summary post-estimates

	Internalizing drugs			**Antidepressants**			**Anxiolytics**			**Hypnotics and sedatives**		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	17–22	17–19	20–22	17–22	17–19	20–22	17–22	17–19	20–22	17–22	17–19	20–22
Panel A: effect estimates												
Years after baseline												
1	0.0007	0.0037	−0.0025	0.0021	0.0032	−0.0000	−0.0010	0.0008	−0.0021	0.0029	0.0025	−0.0006
	(0.0050)	(0.0037)	(0.0042)	(0.0037)	(0.0028)	(0.0031)	(0.0030)	(0.0021)	(0.0025)	(0.0037)	(0.0024)	(0.0032)
2	0.0074	0.0062^{+}	0.0047	0.0044	0.0037	0.0034	0.0057	0.0060*	0.0015	0.0014	0.0020	0.0003
	(0.0049)	(0.0037)	(0.0041)	(0.0036)	(0.0028)	(0.0032)	(0.0035)	(0.0025)	(0.0027)	(0.0037)	(0.0025)	(0.0031)
3	0.0061	0.0071^{+}	0.0017	−0.0013	−0.0006	−0.0024	0.0037	0.0017	0.0028	0.0066	0.0054^{+}	0.0035
	(0.0047)	(0.0040)	(0.0040)	(0.0039)	(0.0029)	(0.0034)	(0.0029)	(0.0019)	(0.0025)	(0.0040)	(0.0030)	(0.0033)
4	−0.0015	0.0028	−0.0047	0.0021	0.0020	0.0008	0.0009	0.0021	−0.0010	−0.0018	0.0013	−0.0043
	(0.0052)	(0.0043)	(0.0045)	(0.0039)	(0.0029)	(0.0034)	(0.0030)	(0.0021)	(0.0026)	(0.0038)	(0.0031)	(0.0030)
Panel B: summary estimates												
After 1–4 years	0.0032	0.0050*	−0.0002	0.0018	0.0021	0.0005	0.0023	0.0026^{+}	0.0003	0.0023	0.0028	−0.0003
	(0.0030)	(0.0025)	(0.0025)	(0.0024)	(0.0019)	(0.0021)	(0.0021)	(0.0014)	(0.0016)	(0.0023)	(0.0017)	(0.0019)
After 2–4 years	0.0040	0.0054*	0.0006	0.0017	0.0017	0.0006	0.0034	0.0033*	0.0011	0.0021	0.0029	−0.0002
	(0.0033)	(0.0027)	(0.0028)	(0.0027)	(0.0021)	(0.0023)	(0.0023)	(0.0015)	(0.0018)	(0.0026)	(0.0019)	(0.0021)
N	406,459	519,321	500,007	406,459	519,321	500,007	406,459	519,321	500,007	406,459	519,321	500,007

Standard errors clustered at the school level in parentheses. All models include individual control variables and school fixed effects. Reference category is cohorts prior to implementation. The coefficients are estimated using the xtreg command in Stata 16.0

$^{+}p < 0.10$; $^{*}p < 0.05$; $^{**}p < 0.01$; $^{***}p < 0.001$

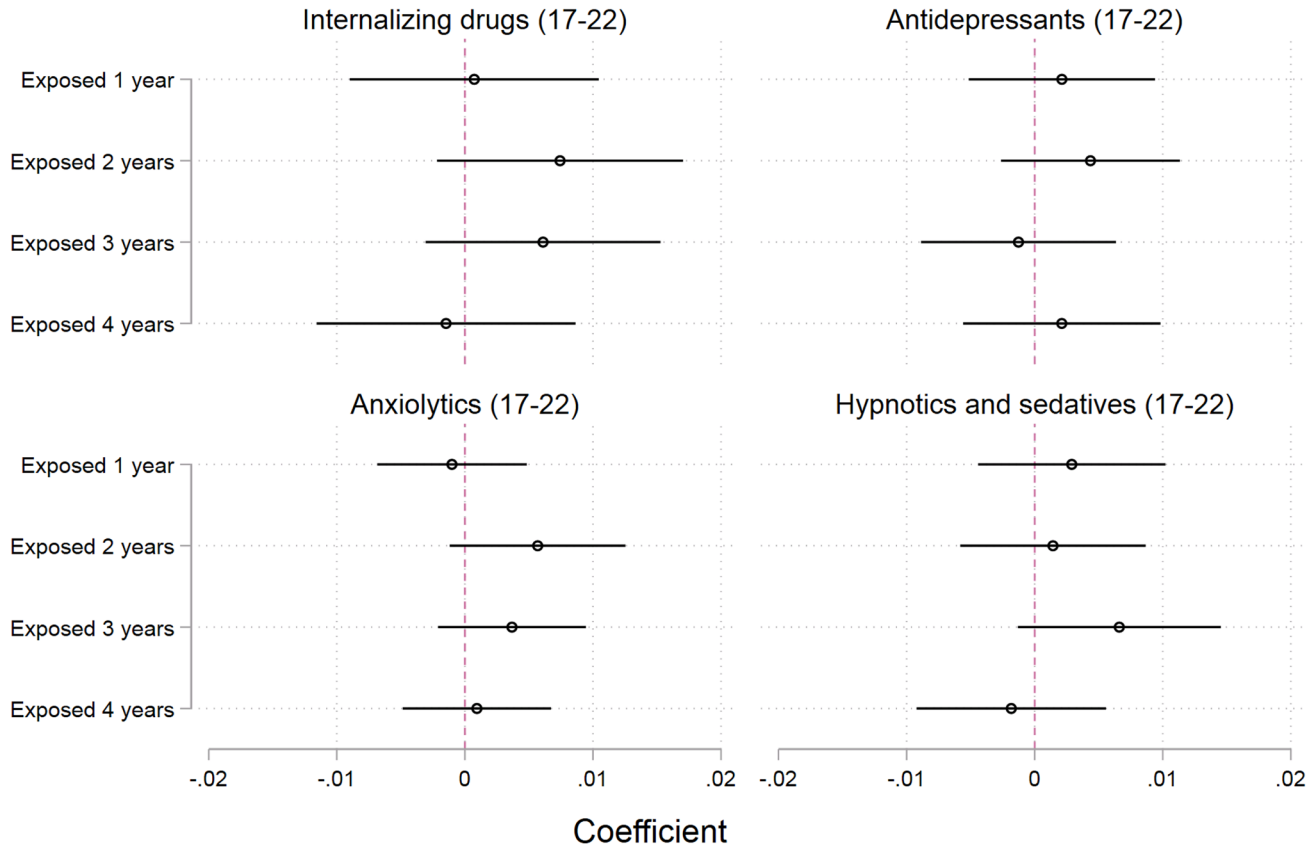

Fig. 2 Effects of OBPP on drug use with 95% CI. Note: see note in Table 3 for details

Concerning different types of internalizing drugs, the effects seem to be weakest for antidepressants, somewhat stronger for hypnotics and sedatives, and strongest for anxiolytics. OBPP increases the likelihood of getting anxiolytics when aged 17–19 by about 0.3 percentage points. Relative to the baseline prevalence of anxiolytics of two percent in this age group, this implies a 15% increase in the use of anxiolytics following the implementation of OBPP (0.002/.020).

The prevalence of internalizing problems and prescription drugs may be higher in specific subgroups of the population, including children who (have) experience(d) victimization. Children with preexisting internalizing problems such as anxiety and depression may be at a higher risk of bullying victimization. These children may also be more vulnerable to victimization experience and in need of professional help. Consistent with this, we find stronger program effects for students who are at higher risk of being prescribed drugs based on general background characteristics such as parental socioeconomic background (see Online Appendix C).

Robustness

In the DiD model, we need a group of control schools that serve as a counterfactual for what the development over time would have been had the treatment schools not implemented the OBPP. Thus, a concern in DiD models is that schools that implement OBPP are on a different development trajectory than the typical control schools. Reassuringly, relaxing the common trends assumption by allowing for differential regional trends does not change the results (Appendix Figure B8).

Although the level of mental health problems among youth is high, psychotherapy is preferred over prescription drugs as treatment, especially in teens; less than five percent of the students in our sample have a prescription for antidepressants, and just above five percent have been given a prescription for anxiolytics or sedatives at least once between ages 17 and 19 (Table 1). Furthermore, even among those with at least one prescription at ages 17–22, few are treated for several years (Appendix Figure B2). The effects of OBPP on long-term use of prescription drugs, as measured by prescriptions at least 3 or 4 years between ages 17 and 22, follow the same pattern as the main results, only the effect sizes are smaller (Online Appendix Figure B12). Whereas these smaller program effects partly reflect lower prevalence, they also indicate that OBPP may affect the extensive margin more than the intensive margin, particularly for hypnotics and sedatives.

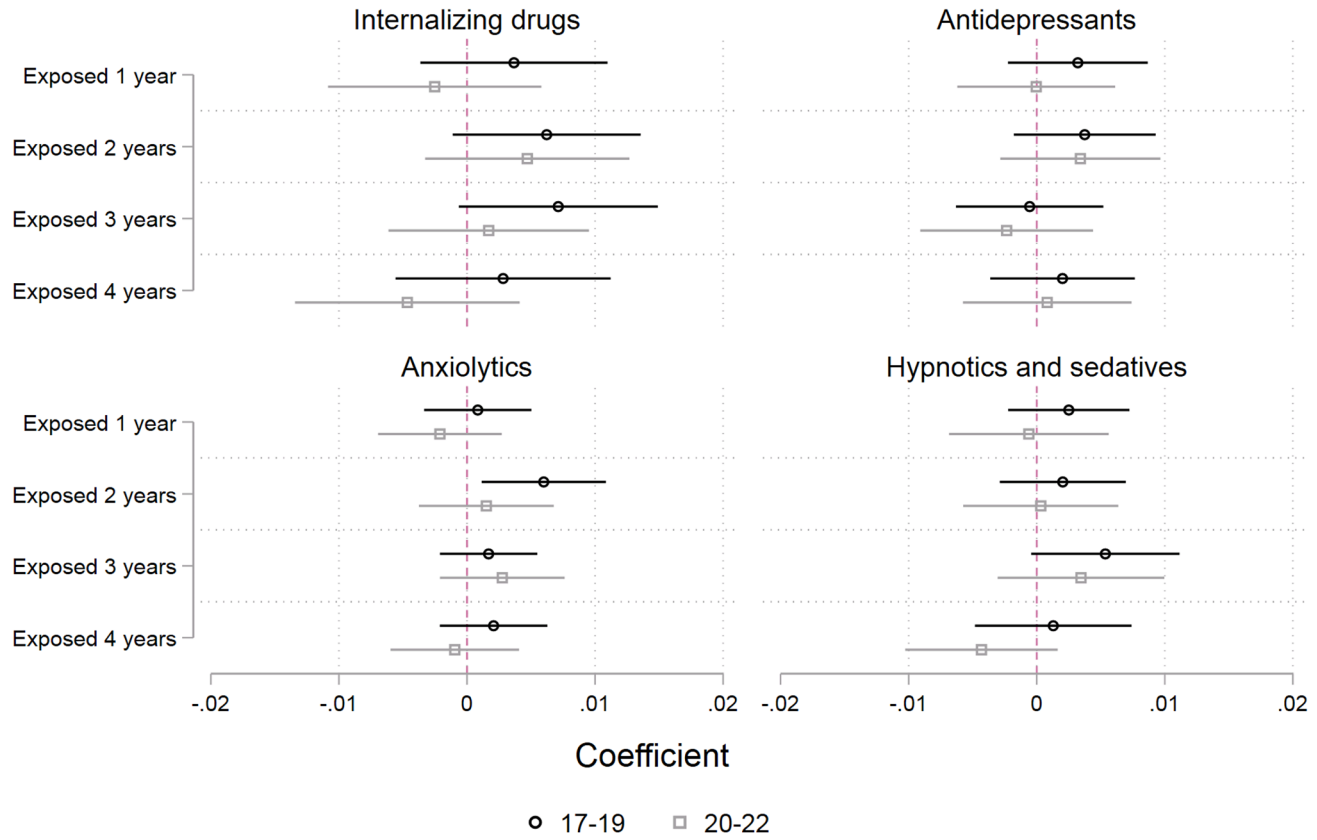

Fig. 3 Effects of OBPP on drug use by age group with 95% CI. Note: see note in Table 3 for details

While the age of 18 has some consequences for what kind of medications are prescribed for internalizing problems (Sidorchuk et al., 2018), this does not seem to affect our program estimates notably. Comparing effects on prescriptions the calendar year students turn 17 and the calendar year they turn 18, we find mostly small differences, except for a slightly higher probability of hypnotics and sedatives at age 18 for those exposed one year (Appendix Figure B9).

Within the class of antidepressants, selective serotonin reuptake inhibitors are the preferred drug for pediatric anxiety disorders. Disaggregating the class of antidepressant drugs into non-selective monoamine reuptake inhibitors, selective serotonin reuptake inhibitors, and other antidepressants demonstrates that for the age group 17–19, the OBPP mainly increased prescribed selective serotonin reuptake inhibitors (Appendix Figures B11 and B12).

Finally, the overall results are strengthened by supplementary analysis showing that the OBPP increases students' mental health care contact with their general practitioner at the age of 20 (Appendix Figure D1). Relative to the baseline prevalence of 8.79%, the OBPP increased mental health contact by about 12% (0.0109/0.0879).

Effects by Continued Use of the Olweus Bullying Questionnaire

Fidelity to the intent of the OBPP and implementation of core program components are essential to achieve a reduction in bullying. Unfortunately, no fidelity data was collected during the implementation stage for the OBPP schools included in this study. However, we observed whether schools continued to use the Olweus Bullying Questionnaire (OBQ) several years after the first implementation, which could proxy the continued use of the OBPP (Olweus et al., 2020). In place of direct measures, the use of this questionnaire serves as a proxy for fidelity in this paper, although, admittedly, a very crude proxy; schools may work after the principles of the program without using the OBQ and, opposite, schools may use the OBQ without working after the principles. Additionally, the implementation may vary between classrooms within schools (Haataja et al., 2014; Olweus & Kallestad, 2010). Before implementing OBPP, schools that continued to use OBQ did not differ from other OBPP schools and control schools as they had students who were found later to have the same level of prescription drugs

(Appendix Table B3). Except for those exposed for 4 years, our results suggest that OBPP increased the likelihood of prescription drugs more in schools that continue with the program than in other schools (Appendix Figures B4–B6).

Discussion

A vast literature has shown that bullying is associated with incapacitating internalizing problems such as depression, anxiety, suicidal thoughts/behavior, and psychosomatic problems, which persist for years after the bullying occurred (Arseneault, 2018; Olweus & Breivik, 2014; Ttofi et al., 2011b), and there is some evidence that bullying prevention efforts may reduce internalizing problems (Palladino et al., 2019; Williford et al., 2012). However, almost no research studies the association between bullying victimization and later use of pharmacotherapy and psychotherapy (Sourander et al., 2007). Moreover, while youth crime and academic failure have been studied (Borgen et al., 2021a), no studies that we are aware of have examined if and how bullying prevention programs affect the use of prescription drugs. Using population-wide Norwegian register data, we find that student cohorts in schools with a higher proportion of 7th graders who are being bullied have more prescribed drugs at ages 17–22. Although OBPP substantially reduces victimization, and hence, assumedly internalizing problems, our results indicate that the OBPP increased the likelihood of being prescribed drugs for internalizing problems between ages 17 and 19 by 0.5 percentage points. Considered relative to the baseline prevalence of 7.9%, this implies roughly a 6.5% increase in the use of internalizing drugs (.005/.079).

Two Contrasting Mechanisms

Our findings may appear counterintuitive given what we know about the effectiveness of the OBPP and the consequences of bullying for mental health problems. However, there are reasons to expect that bullying prevention efforts may increase prescriptions for internalizing problems. Bullying prevention programs such as OBPP may raise awareness among school staff and victimized students of the nature of bullying in school and its damaging consequences, resulting in more victims getting the help they need. Victimized students often keep their experiences to themselves and seldom tell their teachers of their experiences (Blomqvist et al., 2020). Thus, before implementing the program, teachers might be unaware of the extent of bullying victimization in their school and who the victims are. Although OBPP reduces bullying victimization by 30–50%, many victimized students are scarred and traumatized from their experiences and may need long-term professional help (Fisher et al., 2012; Olweus & Breivik, 2014). In this perspective, prescribed antidepressants, anxiolytics, hypnotics, and sedatives can be seen as indicators of students getting help.

The age structure of the program effects (ages 15 to 22) mainly fits with this explanation. Although we find mostly no effect of OBPP on prescriptions at ages 15–16 (Appendix Figure B13), the prevalence of prescriptions is also very low before late teens. Most students with high levels of self-reported anxiety and depression never seek professional help (Gulliver et al., 2010; Zachrisson et al., 2006), and of those who seek help, few are treated with medications (Ask et al., 2019; Skurtveit et al., 2018). Treatment guidelines recommend using medication only when evidence-based psychotherapy has been sub-optimal; this may explain more substantial effects at ages 17–19 than at earlier ages, where students may be treated with psychotherapy if treated at all. No effect of OBPP on prescriptions was found for ages 20–22 either. A possible explanation might be that the oldest age group is in less need of professional help simply because the adverse effects of bullying victimization on internalizing problems seem to decrease over time (Ttofi et al., 2011a). One might also speculate that a proportion of these young adults have already received professional help at a younger age.

The total effects of OBPP on being prescribed internalizing drugs are likely caused by increased awareness of bullying and its negative consequences (which increases drug use) and generally less internalizing problems (which decreases drug use). Of these mechanisms, program effects that operate via less internalizing problems are driven by the change in the number of victims *and* the causal effect of bullying victimization. By reducing bullying victimization by 30–50% in Norway, OBPP may reduce internalizing problems and eventually reduce the likelihood of prescribed drugs. However, some proportion of victimized students who escape bullying may already have developed severe problems and may need long-term professional help (Fisher et al., 2012; Olweus & Breivik, 2014). Furthermore, most students are not directly involved in bullying, and they are probably less affected by the program. The number of victimized students is important because the long-term program effects on the average student (or school cohort) operate mainly through a reduction in the proportion of victimized students. In general, our results indicate that a reduction of bullying victimization by four percentage points reduces prescribed internalizing drugs at the *population level* in the age group 17–19 by only 0.12 percentage points.[4]

[4] Calculated by multiplying the coefficient of bullying victimization of 0.0298 in column 2 of Panel B in Table 2 with 0.04. Note that there is uncertainty both with the estimated effects of bullying victimization on prescriptions (from Table 2) and the estimated effects of the OBPP on bullying victimizations (from other sources). Thus, the effects of the OBPP on bullying victimization via less internalizing problems could be larger or smaller than this point estimate.

In contrast, program effects that we hypothesize operate via increased awareness of bullying which may affect all students, including victims and bystanders. Furthermore, bullying victimization is typically an indicator of mental health problems regardless of whether victimization *causes* mental health problems or students with preexisting vulnerabilities are more likely to be bullied (Arseneault, 2018; Singham et al., 2017). Either way, victimized students with mental health problems may need help from health services. Similar arguments have been put forward concerning crime prevention; since bullying perpetrators are at higher risk of criminal offending later in life (Olweus, 2011), identifying and helping students who bully may interrupt future criminal careers (Ttofi et al., 2011b).

Relatedly, there have been calls for including mental health treatment as part of anti-bullying programs (Sourander et al., 2007). Although offering mental health treatment is not a formal part of the OBPP, the current study results suggest that bullying prevention efforts in schools may help victims (and potentially other students) beyond stopping bullying. For example, the implementation of the OBPP increased the students' likelihood of mental health care contact with their general practitioner at the age of 20 by 12% and their chance of being prescribed internalizing drugs at ages 17–19 by 6.5%. These effect sizes could be considered meaningful, especially considering they are achieved 4 to 7 years after exposure ends (at age 13). A question for future research is whether health care indirectly induced by the OBPP, with more mental health contact with their general practitioner and more prescribed drugs, results in better long-term outcomes for victimized students.

Another potential contributing explanation for why OBPP did not reduce the use of internalizing drugs might be that the damaging effects of bullying victimization are higher when the absolute level of victimization is low, called the Healthy Context Paradox (Garandeau & Salmivalli, 2019; Huitsing et al., 2019; Juvonen et al., 2016; Salmivalli, 2018). More specifically, some research has found that the relationship between bullying victimization and negative emotional reactions such as depression, anxiety, and other adjustment variables may be somewhat stronger in situations where few students are victimized compared to cases where many are victimized—also when the lower level of victimization is a consequence of a successful anti-bullying program. In particular, these exacerbated adverse effects of bullying victimization following an anti-bullying program may be especially salient for children who remain victimized (i.e., stable victims) after the implementation (Garandeau, Lee, & Salmivalli, 2018). If present, higher emotional costs of bullying victimization for the remaining victims may counteract some of the program's preventive effects via less internalizing problems. Note, however, that the empirical support for the Healthy Context Paradox is limited, and, for example, confounding is not yet ruled out as an explanation for this paradox (Garandeau & Salmivalli, 2019).

Limitations and Future Research

This paper has contributed to the literature by showing that the OBPP may increase students' likelihood of being prescribed internalizing drugs. However, prescription drugs are poor proxies for mental health problems. Especially at a young age, a low proportion of students with internalizing problems receive pharmacotherapy (Gulliver et al., 2010), and far from all of those who receive prescription drugs have internalizing problems (Skurtveit et al., 2018). Thus, it is important to note that this paper's results do not inform on the effects of OBPP on internalizing problems in general.

Furthermore, the power to detect program effects of a reasonable size is limited in the current study. First, because of random factors affecting outcomes across cohorts within schools, the confidence intervals may simply exceed credibly possible effects. Second, as in many studies, measurement errors may attenuate our estimates and make it harder to detect significant effects. As discussed in the data and methods section, there is no perfect match between students and schools in our data. Third, the prevalence levels of both key variables of our project—bullying victimization and use of prescribed drugs—are quite low; even in large samples, the number of victimized students who use internalizing drugs in young adulthood is low. Fourth, the implementation of core program components is essential for any effects of OBPP to materialize. Our main effect estimates reflect the average effects of the program as implemented. Although stronger program effects are found in schools continuing to use the OBPP, the continued use of the OBQ is a crude proxy for fidelity, and we have no direct fidelity measures in this study.

Moreover, there are other data limitations. Data on other programs or school practices in control schools were unavailable in the current study. The effect estimates reflect observed outcomes compared to the outcomes one would have expected in the absence of OBPP; increased prescription rates could be explained by control schools implementing other more effective programs, although we find it unlikely, given what we know about OBPP's effectiveness. Nor do we have data about program implementation in grades eight and later, which means we cannot examine the effects of prolonged bullying prevention efforts.

Finally, the bullying survey data in the current project were linked to schools only and not to register data for individual students. The power to detect effects would have been better with a design permitting mediating effects through student-linked bullying data (Pituch & Stapleton, 2012). With such student-linked data, one promising approach would be to compare program effects for victims who

escaped bullying due to the program and effects for students who remained victims despite the program. With the data available in this project, however, it is not possible to identify program effects for individual victimized students, and the effects at follow-up are based on the overall number of students who are prescribed internalizing drugs. Hence, we have a limited opportunity to study the long-term effects of bullying prevention for potential victims in this study and are restricted to studying average population-level program effects.

The effects of prevention programs on prescription drugs are likely to be context-specific and therefore expected to vary by country. Any effects will depend on the bullying prevalence, the effectiveness of the bullying program, and the association between bullying and mental health problems, which effective mental health care services could moderate. The Norwegian context is characterized by relatively low-bullying prevalence combined with a comparatively effective OBPP (Gaffney et al., 2019a, b). An effective bullying prevention program spares more children from bullying in a high-bullying prevalence context, presumably reducing the prevalence of mental health problems more than in a low-bullying context. At the same time, in a high-bullying prevalence context, more children are likely to have scars from earlier bullying, and therefore need to handle psychological consequences. Any attempts to translate our results to other contexts will be speculative and more research is needed into secondary bullying intervention effects in other social environments.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s42380-022-00150-w.

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Data Availability The register data used in this study were made available by Statistics Norway. Access to Norwegian register data, and especially the Norwegian Prescription Database, is strictly regulated. For more information about the application process, see https://www.ssb.no/en/data-til-forskning/utlan-av-data-til-forskere and https://www.fhi.no/en/hn/health-registries/norpd/norwegian-prescription-database/.

Declarations

Ethical Approval The data collection is in accordance with legislation and approved by the Norwegian Data Protection Authority and approved by Regional Committees for Medical and Health Research Ethics in Norway. The research is conducted in line with ethical guidelines set by the National Committee for Research Ethics in the Social Sciences and the Humanities (NESH).

Conflict of Interest As a developer of the Olweus Bullying Prevention Program (OBPP), Dan Olweus receives author royalties for various publications about the program. Kyrre Breivik and Mona Elin Solberg were members of Dan Olweus' research group at the University of Bergen, and are currently involved in research on and further development of the Olweus program at the Regional Centre for Child and Youth Mental Health and Child Welfare. This center has a non-profit policy, and the OBPP is offered free to Norwegian schools. The anti-bullying work is financially supported by national authorities (the Norwegian Directorate for Education and Training and the Norwegian Directorate of Health). All other authors declare that they have no conflict of interest.

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