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INVITED COMMENTARY

Unintended Consequences: The Potential for Adolescent Health Interventions to Have Unexpected Effects

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The field of sexual health education is under scrutiny and we need to discuss it. Although there is a long history of sexual health programs in the field of public health, in some cases, well-intentioned interventions can end up having unintended effects and undesirable outcomes. Adverse effects of such public health interventions are rarely reported in the literature (Lorenc & Oliver, 2014); however, some studies have investigated and identified unintended outcomes. Examples of adverse effects have been related to programs designed to prevent bullying (Yeager et al., 2015), substance use (De Cock et al., 2017) and depression (Kindt et al., 2014), and these findings are important to help mitigate undesirable effects in the future.

In this invited commentary, we aim to initiate and encourage discussion about this topic by articulating issues related to the adverse effects of interventions in the context of adolescent sexual health education, highlighting possible obstacles that researchers may have in publishing such results.

When it comes to sensitive content like sexual risk behaviors, adverse effects of interventions are rarely presented or discussed in the literature. Furthermore, considering that a program may tackle a range of factors that influence sexual behavior, even if the program does not directly target sexual behavior itself, it may unexpectedly affect it. For example, our recent program evaluation found that a school-based substance use prevention program for adolescents had iatrogenic effects on two outcomes: alcohol use initiation (Sanchez et al., 2017, 2018) and unsafe sexual behaviors (Reis et al., 2021).

The intervention that we evaluated, the *#Tamojunto* Program, was based on the global social influence model (Sussman et al., 2014), with the goal of reducing alcohol and drug use by enhancing personal and interpersonal skills while transforming beliefs and normative perceptions to minimize the impact of social factors that foster adolescent drug use (Giannotta et al., 2014). The program was originally created as a drug use prevention program for European adolescents, with no content related to sexual behavior. Given that risk behaviors in adolescence tend to share underlying determinants that may protect or predispose adolescents to engage in risk behaviors (Jackson et al., 2012), we hypothesized that targeting one behavior could possibly also have an influence on other behaviors. Therefore, we expected there might be program benefits that would spillover to other health domains (e.g., sexual behaviors and alcohol initiation). This idea is supported by the literature, showing that substance use during adolescence may cluster with early sexual risk behaviors (Son et al., 2016).

To test these hypotheses, we conducted a randomized controlled trial among 6391 11- to 15-year-old students in Brazil. Comparing participants in the intervention and control arms, receipt of *#Tamojunto* was associated with higher risk of alcohol initiation, lifetime sex and condomless sex. Students in the experimental group had a 30% and 13% increased risk of initiation of alcohol use at 9- and 21-month follow-up, respectively (Sanchez et al., 2017, 2018). *#Tamojunto* was also associated with a 27% increase in risk of lifetime engagement in sexual activity at follow-up at 21 months after the program initiation. Girls in the intervention group had a higher likelihood of having engaged in both sex and condomless sex in the last month (Reis et al., 2021). Given that these results suggest adverse effects of the program on behaviors not specifically targeted by the program, they highlight the importance of having comprehensive program evaluations that examine a wide variety of targeted as well as untargeted effects.

Adolescents tend to engage in risky behaviors that can lead to negative health outcomes and adverse social consequences (Vadrucci et al., 2016). Over the last three decades, sexual health education has been an important focus of public health, with interventions targeting a variety of contexts: the family, school, foster-care system and community (Goesling et al., 2014). When

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it comes to adolescents and sex education, dealing with adverse effects can be especially challenging due to a possible cascade of negative factors. First, deviant behaviors (e.g., stealing money, drinking, smoking) tend to lead to yet more deviant behaviors. For instance, substance use is a risk factor for early sexual intercourse or condomless sex (Boisvert et al., 2017), problems that rarely occur in isolation. Second, other actors, apart from the youth at risk, tend to play significant roles in influencing adolescent behavior. On the one hand, some parents may disagree with proposed prevention programs and stop their children from fully participating (Mathews et al., 2009; Price & Hyde, 2009), and on the other hand, peer exposure can aggravate aggressive behaviors (Gatti et al., 2009).

Particularly when financial resources are scarce, it is important to consider evidence-based interventions in order to minimize negative results. And yet, evidence-based interventions do not guarantee positive results, since a range of conditions can affect the desired outcomes: the context, participant characteristics, transcultural adaptation, etc. In fact, we could say that evaluating the effects of health promotion interventions is a complex process in which all details and parameters are relevant. Nonetheless, although evaluation of sex education programs is challenging due to these complexities, they are important to consider. Identifying potential harm as well as investigating mechanisms that might moderate them (so that they can be avoided in the future) are critical for public health interventions. Last but not least, after detecting and characterizing adverse outcomes, it is crucial to inform the academic community and report these results accurately. Not addressing and not publishing the existence of adverse effects is counterproductive to researchers, educators, parents and, more importantly, to our target population of adolescents.

Ironically, while we as public health researchers often study vulnerable populations, we tend to avoid allowing ourselves be vulnerable in relation to others. Perhaps due to a fear of being criticized by our peers or rejected by funding institutions (for fear of gaining a reputation for implementing failed programs), we may avoid exposing adverse effects that exist in our research and/or program implementation. There is also an external barrier related to publication bias when trying to disseminate results about adverse effects—peer-reviewers or editors may be reluctant to recommend or prioritize publishing findings that are counter to expectation or hard to explain. As suggested by the scarcity of papers on public health interventions that report adverse effects (Bonell et al., 2015), we need to permit ourselves both to experiment and to possibly fail—of course, within reasonable limits. After all, it is within the uncomfortable space of exploring the unknown that novel possibilities and new ideas for interventions can see the light of the day, by exposing the truth and shedding light on effective ways to improve public health.

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