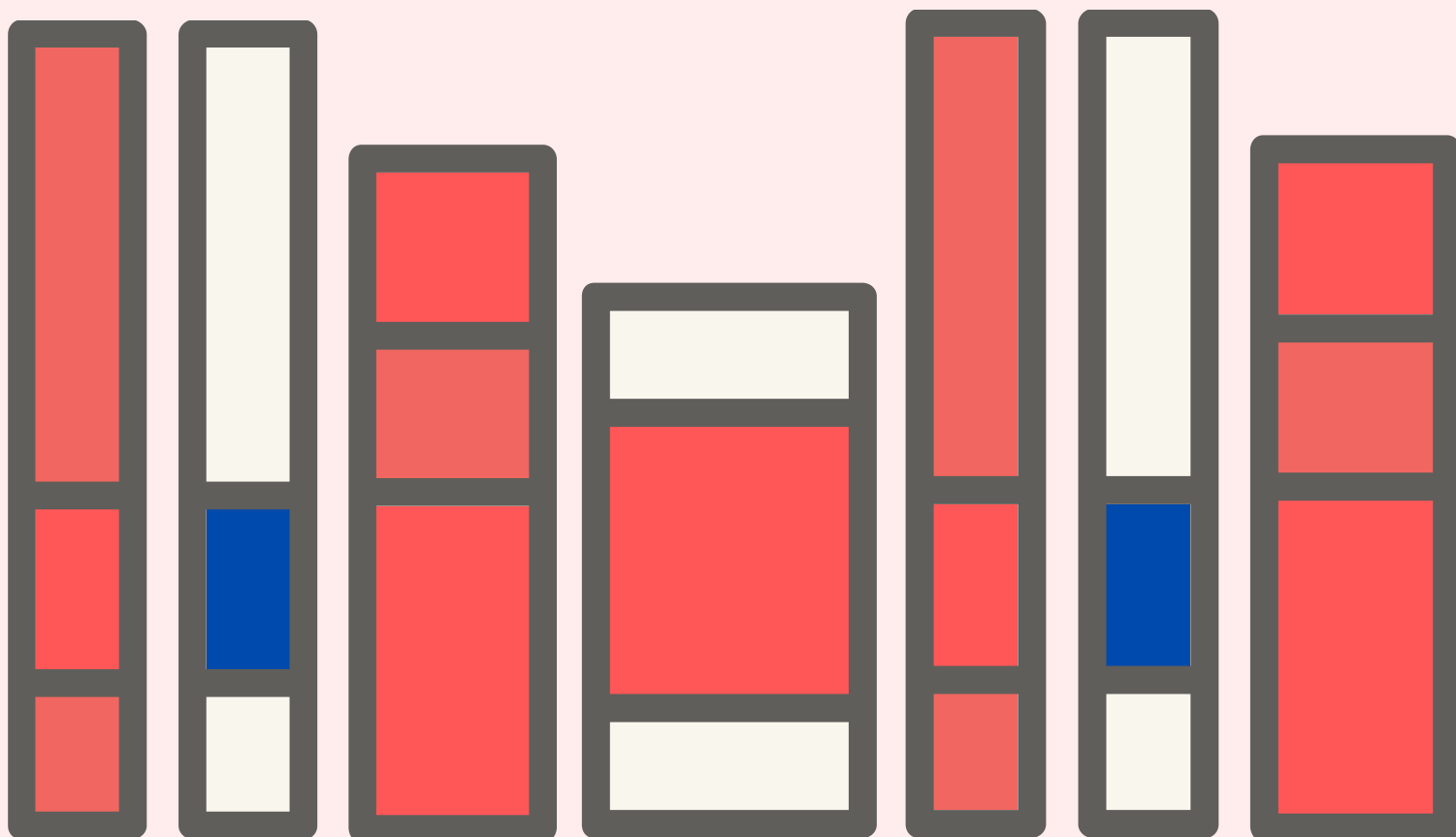


**Editor**  
Inajara Rotta

# Adolescent Pregnancy Prevention: Educational Strategies and Implementation in Public Health



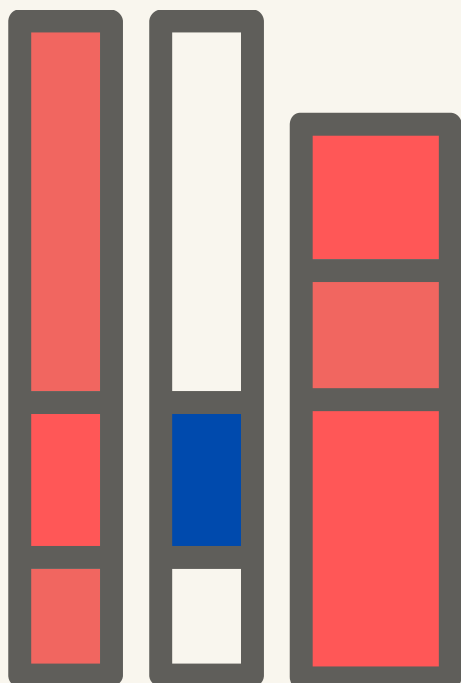
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Inajara Rotta

# Adolescent Pregnancy Prevention: Educational Strategies and Implementation in Public Health

**1st Edition**  
**2023**



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# Adolescent Pregnancy Prevention:

## Educational Strategies and Implementation Science for Public Health

1st Edition 2023

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# Adolescent Pregnancy Prevention: Educational Strategies and Implementation Science for Public Health

1st Edition 2023

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## Abstract

Pregnancy in adolescence is a global public health issue that remains in need of addressing. Although its prevalence has declined in some countries and regions in recent years, it remains high. Some factors may predict pregnancy in adolescence, such as age, marital status, healthcare system, family structure, mental health, educational and socioeconomic status. In addition, in this chapter, we briefly discuss its health, social, and economic impacts. Adolescent mothers and their babies are likely to face a variety of negative health-related outcomes, including consequences related to mental and physical health, such as depression, increased risks of anemia, preeclampsia, preterm birth, low birth weight babies, and miscarriages. The socioeconomic impact, on the other hand, may include academic failure, substance abuse, poverty, unemployment, and intimate partner violence. Thus, intervention programs or public health initiatives should be adopted to implement effective strategies to prevent unwanted adolescent pregnancy worldwide.

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## Introduction

Adolescence is the phase of life in which the person has not yet reached adult status but is no longer considered a child which, according to the World Health Organization (WHO), includes ages between 10 and 19 years [1]. In addition, adolescence can be categorized into three stages: early (10-13 years), middle (14-16 years), and late (17-19 years) [2]. However, some scientists say that adolescence lasts until 24 years [3]. It is a critical phase of intense physical and psychosocial changes, affecting how adolescents think, feel, make decisions, and interact with the world around them [1,4].

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An important issue that arises during adolescence is sexuality. The increased sexual behavior in this phase is a consequence of the increased production of sexual hormones [2,5]. In some societies, sexuality is still little discussed, remaining a taboo for teenagers. In some regions of the world there is no formal sex education in schools. As a result of this, over time, adolescents have had their first sexual intercourse earlier, and often unprotected [2]. For example, a Brazilian study showed that 63.4% of the interviewed adolescents were sexually active and the mean age at first intercourse was 14 years (range: 7-18 years); only 56.25% reported that they used a condom during the first sexual intercourse [6]. Early exposure to sex increased the risk of sexually transmitted infections (STIs) and teenage pregnancy, mostly unwanted [2,7].

Teenage pregnancy is a global public health problem, especially in low- and middle-income countries, and therefore remains an important issue to be discussed [8]. Tackling the issue of teenage pregnancy is essential to achieve

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better health and social equality, avoiding undesirable health outcomes and positive impacts on women's empowerment, as pointed out by the Sustainable Development Goals (SDG) [8]. This chapter addresses the epidemiological data on teenage pregnancy, such as its prevalence and associated factors, as well as its health, social, and economic impacts.

## Prevalence of pregnancy in adolescence

According to the WHO, adolescent pregnancy is characterized as pregnancy occurring in girls aged between 10 and 19 years [9]. Besides the previously mentioned adolescence classification in three age ranges, which takes into account physiological aspects, the WHO additionally subdivides pregnancy in adolescents in two ranges: early adolescent pregnancy, which includes girls from 10 to 14 years of age, and late adolescent pregnancy, comprising pregnant girls aged between 15 to 19 years [10]. This subdivision is important, not only because of the different physiological and psychological levels of maturity, or rather prematurity, but also because of the different social contexts under which pregnancy occurs in early and late adolescence [10], such as child marriage, often forced, lack of access to contraceptives, and information about contraception [11].

When talking about teenage pregnancy, one cannot ignore the correlated institution of child marriage. Child marriage is recognized as a human rights violation [12], and by various international conventions, such as "The Universal Declaration of Human Rights" [13], "The Convention on the Elimination of All forms of Discrimination against Women" [14], and the "Convention on the Rights

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of the Child" [15]. Additionally, the SDG, adopted by the United Nations in 2015 as a universal call to action to achieve a better and more sustainable future for all people in the world, explicitly states on indicator 5.3.1, in respect of goal 5, which aims to "Achieve gender equality and empower all women and girls", by eliminating harmful practices, such as child, early and forced marriage (as well as female genital mutilation) [16].

The SDG additionally considers adolescent pregnancy as a health issue, covering it on goal 3. Indicator 3.7.2 understands the need of ensuring healthy lives and promoting well-being for all at all ages, by, amongst others, controlling adolescent birth in girls under 18 years of age [17]. The following two sections describe epidemiological aspects of pregnancy in early and late adolescence, respectively.

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## Marriage and pregnancy in early adolescence (10-14 years old)

Although data on early adolescent childbirth is often scarce, due to underreporting and concealment of information [10,18], child pregnancy is highly associated with forced child and early marriages [19].

The United Nations Population Fund and the International Center for Research on Women calculate that approximately 10% of girls in developing countries are married before the age of 15. Considering data from 2020, which estimates the number of early teenagers in roughly 545 million people from the less developed regions, approximately 54.5 million girls under the age of 15 were

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married in this year. This undesirable phenomenon is significantly associated with poverty. Countries located in Western and Sub-Saharan Africa present high prevalence of child marriage, while South Asia presents the largest numbers, due to higher population. Regarding income, the rate of married girls originating from poor households can be as high as the double of those originating from higher income households [12,20].

Regarding childbearing, despite the recent global diminishing rates since the year 2000, rates and absolute numbers are still far from reaching desirable levels. The African continent is the only region to contain countries with rates of early teenage pregnancies between 4 and 8 births per 1,000 adolescents between 10 and 14 years of age, and despite the decline in relative numbers, the total number of childbirths has grown following population growth under the same age range. Some countries in Latin America, Eastern Europe, and the Middle East reach rates of 3 births per 1,000 early adolescents, while the other regions of the world achieved the rate of maximum 1 childbirth per 1,000 early adolescents. Albeit it is important to note that similarly to early marriages, South Asian countries, despite lower rates of childbirth in young adolescents (1 per 1,000), may present higher absolute numbers [19].

In absolute numbers, the region with the highest childbirth rate in 2021 was sub-Saharan Africa, with a total of 332 000 births among adolescents between the ages 10 and 14. South-East Asia presented the lowest number with a corresponding 22 000 [21].

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## Marriage and pregnancy in late adolescence (15-19 years old)

Regarding child marriage in late adolescence, poverty and geographic patterns exert the same influence as in early adolescence, in a higher magnitude. Except for Mauritania and Somalia, in which the proportion of married girls under 15 to married girls between 15 and 18 is around the ratio of 1:1, the majority of countries present ratios ranging between around 1:2.4 to 1:5 [22].

Relative to childbearing, the WHO estimates that in low- and middle-income countries, 21 million teenage pregnancies (15 to 19 years) occur each year and although declines have occurred in all regions, sub-Saharan Africa, Middle East, South Asia and Latin America and the Caribbean continue to have the highest rates globally between 20 and 180 births per 1000 women in 2021 [8,19]. Although the estimated global rate of childbearing in adolescents has declined, absolute numbers remain high. Sub-Saharan Africa accounted for approximately 6 million total births in adolescents from 15 to 19 years of age in 2021, while Central Asia presented the lower number of births occurring in the same age range, estimated at 68 000 [21].

## Factors associated with pregnancy in adolescence

Teenage pregnancy is a significant worldwide health concern that negatively affects childbirth outcomes and can result in intergenerational poverty and poor health [23], with lasting consequences for both the mother and

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child [24]. There are several significant predictors of this phenomenon, including age, educational status, marital status, and community wealth status [25].

The following sections aim to provide an overview of these factors that have been associated with pregnancy in adolescence. Specifically, the following factors were evaluated: age, marital status, healthcare system, family structure, mental health, educational status, and socioeconomic status (see **Figure 1**). By identifying and discussing these factors, this section seeks to contribute to a better understanding of the complex and multifaceted nature of teenage pregnancy. Furthermore, the insights provided may aid in the development of effective interventions to address this public health issue.



**Figure 1.** Factors associated with pregnancy in adolescence

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## ⊙ *Age*

A study that analyzed teen pregnancy in Ethiopia has demonstrated that age is a critical predictor for this event. The authors discovered that teenagers aged 17 and above are at higher risk of experiencing pregnancy compared to 15-year-olds [25]. This finding is consistent with another study performed in Ethiopia that showed that with each additional year of age, the odds of pregnancy increased by 2.1% [26]. A study conducted in Nigeria also found a significant relationship between increasing age and teenage pregnancy [27]. This is likely because as adolescents age, they have more exposure to sexual activity and may also become more likely to get married, which can increase the chances of pregnancy [25,26].

## ⊙ *Marital status*

Studies conducted in Bangladesh [28,29], Uganda [30] and Nepal [31] have found a consistent relationship between married teens and pregnancy. Married teenagers were found to have a higher risk of experiencing teenage pregnancy than single teenagers [25].

One study carried out in Nigeria found a statistically significant relationship ( $p < 0.05$ ) between teenage marriage and pregnancy. The authors suggest that this may be due to the traditional view of marriage, which emphasizes childbearing. According to the authors, if a couple is unable to conceive after marriage, the woman may be sent back to her family and the man may marry someone else [27]. Therefore, teenage girls may experience significant

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pressure to prove their fertility and strengthen their position in the family through childbirth [32]. Additionally, another factor that was suggested by a study in Iran, which found a high prevalence of teenage marriage in Iranian society, is that teenage girls are not empowered or adequately prepared for marriage and birth control [32].

## ⊙ *Healthcare system*

The limited access to health services can result in limited access to health promotion and contraceptive methods, which in turn can increase the incidence of teenage pregnancy. This is particularly true when there is a lack of health education initiatives. Additionally, the inability to obtain free contraceptives and the lack of privacy may also contribute to the non-use of contraceptives and risk behavior, increasing the risk of pregnancy [33].

The low quality of educational and counseling in the healthcare system has also been identified as an important factor contributing to teenage pregnancy. This is because it affects women's awareness of contraceptive methods, which remains low due to the poor quality of educational services [32].

## ⊙ *Family structure*

Studies suggest that family structure is linked to teenage pregnancy. A study conducted in Finland analyzed sociodemographic differences in the occurrence of teenage pregnancies and found that girls whose family

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composition was other than living with both parents had 2.3 times the pregnancy risk compared to those who had such a family structure [34].

Similarly, a study conducted in Ethiopia found that teenagers from divorced parents were nearly two times more likely to be exposed to teenage pregnancy compared to adolescents from married parents [26]. Furthermore, a cross-sectional survey conducted exclusively with boys in Sweden revealed that those who had been involved in a pregnancy were more likely to come from households that had experienced a family breakdown [35].

There are several studies from various places in the world that highlight the importance of family structure in preventing teenage pregnancy. For instance, research conducted in England [36] found that unstable family structures were associated with a significantly greater risk of teen pregnancy. This finding is consistent with another study that analyzed teenage pregnancy in both the United States and Canada [37].

According to Bonnel et al. [36], young women who live with their mothers may have an advantage in discussing sexual subjects, which could be a contributing factor to preventing teenage pregnancy. However, Habitu's study [26] suggests this communication advantage is not as prevalent among adolescents with divorced parents, which can lead to increased early sexual debut and risky sexual behavior, ultimately increasing the risk of teenage pregnancy.

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## ⊙ *Mental health*

Mental health plays a significant role in understanding teenage pregnancy. One study conducted in the United States with young women aged 13 to 24 found that those with depressed mood or psychological stress are more likely to discontinue oral contraceptives, which may result in unintended pregnancy [38].

Another study that highlighted the link between mental illness and teenage pregnancy was a cross-sectional study conducted in Canada that analyzed the fertility rates of adolescent girls with major mental illness (including psychotic, bipolar, or major depressive disorder) compared to those without mental illness. The study found that the pregnancy rate was almost three times higher among adolescents with mental disorders [39]. These studies underscore the significance of considering mental illness when designing and executing pregnancy prevention programs.

## ⊙ *Educational status*

The association between educational status and adolescent pregnancy has been consistently identified in numerous studies [40]. Lower levels of education have been found to be associated with higher odds of teenage pregnancy, as evidenced by studies conducted, for example, in Nepal [41], Pakistan [29], and Bangladesh [42].

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A multilevel analysis study also corroborated these findings, revealing that primary and below-educated teenagers had higher odds of experiencing teenage pregnancy than secondary and above-educated teenagers [25]. This result is also consistent with studies conducted in Ethiopia [43], Nigeria [27], Philippines [44], and Japan [45].

A study conducted in Finland found that, in addition to the educational status of the adolescent, the father's educational level was also linked to early pregnancy in the family. The study revealed that girls whose fathers had less than nine years of education were 2.2 times more likely to become pregnant than those whose fathers had completed twelve years or more of education [34].

It is believed that educated adolescents have better knowledge and skills to prevent pregnancy, while those with limited education have limited access to sexual and reproductive health information and services, making them more vulnerable to pregnancy. Additionally, higher levels of education are associated with delayed marriage and greater confidence in rejecting early marriage and sexual abuse [40].

## ◎ *Socioeconomic status*

Studies conducted in South Asia have consistently reported that low economic status is associated with higher risk of adolescent pregnancy [40]. This trend has also been observed in other countries, such as Bangladesh, Nepal, and

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Pakistan, where studies have shown that women of lower economic background are more likely to experience teenage pregnancy [28,29,46,47].

Kefale's study [25] has found that teenagers living in communities with higher proportion of poverty face a greater risk of teenage pregnancy due to several factors such as limited access to education, sexual and reproductive health services, early marriage and school dropout. Furthermore, research has shown that racial and ethnic disparities are important social determinants of health and healthcare access, which could also be associated with adolescent pregnancy. According to Martin et al. [48], birth rates among different racial and ethnic groups indicate that adolescent pregnancy rates are about twice as high in Hispanic and non-Hispanic Black teens compared to non-Hispanic White teens. Additionally, American Indian/Alaska Native teens have a rate approximately 2.5 times higher than non-Hispanic White teens. These findings highlight the significant role that racial and ethnic disparities play in determining social determinants of health, including access to healthcare.

## Health, social, and economic impacts of pregnancy

Unintended pregnancies among adolescents result in health, social, and economic burdens to both individuals, families, and communities. This includes unsafe abortions [8] and several pregnancy complications, culminating in preterm delivery, with serious consequences for child development, or maternal and neonatal death [9]. Globally, health-related evidence shows that

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complications resulting from pregnancy and childbirth are the leading cause of death for girls aged 15 to 19 years [49].

Several adverse perinatal outcomes have been associated with adolescent pregnancies, specifically, preeclampsia, preterm birth, low birth weight babies, and an increase in stillbirths, intrapartum deaths, and miscarriages [50]. Wilson et al. [51] reported a risk more than 4 times of intrapartum stillbirth in the youngest teens and 50% higher in teens 15 to 19 years old compared with women aged 20 to 24. Furthermore, adolescent mothers face increased risks of pregnancy-induced hypertension, prolonged labor, puerperal endometritis, systemic infections, and anemia [52,53].

Annually, it is estimated that 3.9 of the 5.6 million abortions that occur among adolescent girls aged 15 to 19 years are unsafe, thereby contributing to maternal mortality, morbidity, and lifelong reproductive health problems [54]. Lambonmung et al. [55] found that abortions were a dangerous practice among teenage mothers, because most of them were conducted with unsafe methods or were unsafely terminated, including techniques such as insertion of objects into the vagina or the use of a combination of drugs and herbal substances.

Perinatal mortality rate in adolescent pregnancy is at 11.2%, which is 1.9 times higher than in other pregnancies [56]. Regarding perinatal complications, low birth weight (< 2500 g), preterm delivery, and lower Apgar score are frequently observed. In the postpartum as well, it is asserted that hemorrhage, anemia, depression, and urinary, sexual, and breastfeeding problems occur at a higher rate in adolescent mothers [57].

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In a systematic review performed by Karaçam and colleagues, they revealed the following criteria as more prevalent in adolescent pregnancies: preterm labor, early membrane rupture, anemia, inadequate prenatal care, low birthweight, intrauterine growth retardation and fetal distress. Moreover, this study showed that pregnant adolescents and adults exhibited similar outcomes in terms of preeclampsia/gestational hypertension, eclampsia, breech presentation/abnormality and cephalopelvic disproportion/dystocia [58]. Additionally, it is known that the younger the patient, the greater the risk, with rates of infant mortality, very low birth weight and preterm delivery [50].

On the other hand, in a retrospective analysis of the Centers for Disease Control and Prevention, Eliner et al. [59] found that teen pregnancies were associated with increased odds of several maternal complications, such as hypertensive disorders of pregnancy, eclampsia, preterm birth, blood transfusion, and chlamydial and gonorrheal infections. Also, it was associated with increased odds of several neonatal complications, including congenital birth defects, low 5-minute Apgar score, suspected neonatal sepsis, and assisted ventilation. Nevertheless, in this study, teen pregnancies were associated with decreased odds of gestational diabetes, unplanned hysterectomy, macrosomia, low birth weight, and neonatal intensive care unit admission.

In addition, pregnancy may lead to mental disorders in adolescent girls, such as suicidal ideation, anxiety, depression, and stress [60]. Depression symptoms among young mothers are also more likely to persist after the birth of their child [61]. Attention with postpartum depression is especially important in

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adolescent mothers since studies consistently show that they are at a higher risk of developing the condition than adults [62,63] with incidence rates reported at 14 – 32% and 7.2 – 16%, respectively [64,65]. Bottino et al. [66] predicted that maternal age was significantly associated with postpartum depression independently of socioeconomic, reproductive characteristics or conjugal status. Thus, for each additional year, a reduction of 4% in the chance of developing this condition could be anticipated.

Furthermore, postpartum depression could affect both the mother and her developing infant. In a study of 180 adolescent mothers, Huang and colleagues [67] found higher levels of maternal depression were also associated with more negative impacts in the form of delayed child development [68]. Additionally, Lambonmung and colleagues [55] also found that pregnant teenagers face sadness and unhappy mood, moderate to severe depression, feelings of fear, anger, and shyness. Findings of pregnancy-related stress, suicidal thoughts, ideation and feelings of rejection, fear, self-condemnation, guilt, and poorer coping ability and attitude toward pregnancy were highlighted in this study.

It is also known that some adolescent mothers experience great difficulty returning to school after birth [69]. Adolescent pregnancy can be a barrier to education in the population, keeping young women from achieving professional roles and benefiting from economic resources [58]. For Diaz and Fiel [70], teen mothers are less likely to complete high school, attend college, or earn a bachelor's degree, and they tend to earn less and are more likely to experience poverty, thereby impacting their future education and job opportunities [71].

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Teenagers who become pregnant are unable to contribute to production, causing increased health expenditure and creating a significant economic risk for society [58]. In addition, the WHO indicates that adolescent pregnancy occurring outside the context of marriage may have social consequences such as stigma, rejection and/or violence by partners, parents, or peers [8].

The social consequences pointed out for adolescent motherhood include academic failure, alcohol and substance abuse, isolation by parents and friends, stigma, poverty, unemployment, and intimate partner violence [72]. Evidence exists that children born to adolescent mothers are likely to become adolescent mothers in the future [45]. Consequently, this impact is not restricted to adolescents and their families but extends to the social sphere.

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Regarding the cost of teenage pregnancy, Kohn et al. [73] estimated that adolescent pregnancies cost \$11,237 per person, which is even higher for adolescent pregnancies with uncomplicated pregestational diabetes (\$14,155 per person) or for cases with ketoacidosis or end-organ damage (\$29,810 per person). In addition to the expenses due to health problems resulting from teenage pregnancy, the negative economic consequences can also be due to school dropout or impaired school performance, which makes participation in the labor market more difficult, contributing to poverty [74]. A study showed that teenage pregnancy reduces women's wages by 30% [75]. Moreover, Mexican data showed that learning losses and school dropout secondary to teenage pregnancy represent an estimated annual loss of more than \$1 billion [76]. Therefore,

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reducing pregnancies in this age group could save millions of lives, improve the social status of young women, reduce health costs, and strengthen the economy.

## Conclusions

This chapter introduced the topic of pregnancy in adolescence and its associated factors. It showed how impactful this is for the health of the mother and baby, its social consequences, and how costly it can be. Therefore, intervention programs or public health initiatives should be adopted to implement effective strategies to prevent unwanted adolescent pregnancy worldwide.

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## Abstract

Health education is an important tool for health promotion and focuses on building individuals' capacities through educational, motivational, skill-building and consciousness-raising techniques. Comprehensive and abstinence-only educational interventions are the two approaches that employ structured knowledge without the need for high-tech resources and are focused on the prevention of pregnancy in adolescence. Comprehensive interventions include both abstinence and responsible sexual behavior as effective methods and aim to reduce risky sexual behaviors, like unprotected sex, and consequently the risk of pregnancy, HIV, and other sexually transmitted infections (STIs). Abstinence-only interventions promote abstinence from sexual activity, being considered the only certain way to avoid pregnancy and STIs. Secondary, studies demonstrated that the evidence on the effectiveness of comprehensive interventions is inconsistent, owning a lot of heterogeneity in the results of the studies and the evidence about the effectiveness of abstinence-only interventions is scarce, as well as the results showed no significant benefits in the prevention of pregnancy.

**Keywords:** educational interventions; comprehensive; abstinence-only.

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## Introduction

The rise of the health concept, addressing issues such as quality of life and social well-being, is related to a change of perspective encompassing what are the necessary measures for maintaining and promoting the health of a population. Moreover, in order to guarantee the right to health, the complexity of individuals regarding social, cultural, religious, and political issues must be considered. To achieve this goal, health technologies must be adopted [1].

The health technologies are classified into hard, soft-hard, and soft. Hard technologies include technological equipment, machines, norms and organizational structures, while soft-hard technologies include well-structured knowledge applied for a certain purpose, such as for the prevention, diagnosis or treatment of health conditions [2]. Furthermore, soft technologies are based on care methods to welcome individuals, considering their needs, and offering a relationship of learning, thus promoting autonomy over their own health and wellness. Soft technologies include educational interventions provided to a determined population in which structured knowledge is used without the need for high-tech resources and that aim to improve health conditions, allowing the individuals accepting or rejecting new information and may or may not lead to behavioral changes [2,3].

Educational interventions such as strategies focused on preventing teenage pregnancy must establish bonds with adolescents, facilitating their acceptance. These interventions include actions that result in greater knowledge

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and autonomy of this population, expanding their decision-making capacity regarding their behavioral choices [4,5].

These approaches can be classified into comprehensive or abstinence-only interventions, depending on whether the focus is only on postponing the onset of sexual activity and abstinence, or whether it includes education on the use of contraceptive methods and the importance of safe sexual behavior [6].

This chapter addresses the concept of educational interventions and promotes discussion about the comprehensive and abstinence-only approaches focused on the prevention of pregnancy in adolescence.

## Educational interventions

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Health education is a tool for health promotion and disease prevention through education-driven behavior change activities. These activities can enable people to increase control over and to improve their health and may occur in schools, workplaces, clinics, and communities, including topics focused on behavioral changes, such as healthy eating; physical activity; tobacco control and smoking prevention; pregnancy and STIs prevention [7].

Health education focuses on building individuals' capacities through educational, motivational, skill-building and consciousness-raising techniques and its effectiveness can be evaluated by improvement on health literacy and behavioral changes [7]. It is important to highlight that health education should not be seen as a set of imposing practices, which aim to prescribe ideal behaviors,

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disregarding the reality of social subjects, with no guarantee of effectiveness in strategies and actions [8].

In this context, health technologies can be considered allies to reach established goals. Soft technologies address relationships, bond establishment and communication and include educational interventions which represent important tools that seek to implement health promotion actions, considering human pluralism and valuing their experience and expectations regarding the health-disease process [2,3]. Although educational interventions are classified as soft technologies due to their relationship-building character and because they require little technology, depending on which tools and methods were used in their work process, they can be classified into other levels [9,10].

## Educational interventions focused on the prevention of adolescent pregnancy

Sexual education can be defined as any combination of learning experiences aimed at promoting protective behaviors related to sexual health and can be delivered through comprehensive or abstinence-only interventions [11].

The distinction between these two approaches reflects a longstanding debate among parents, providers, and policymakers about the most appropriate content and focus on the aim of preventing adolescent pregnancy [6]. Comprehensive interventions

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Comprehensive educational interventions address cognitive, emotional, physical, and social aspects of sexuality, representing strategies to reduce sexual risk behaviors, preventing or reducing the risk of pregnancy, HIV, and other sexually transmitted infections (STIs) [6,11,12]. This approach includes both abstinence and responsible sexual behavior as effective methods, highlighting the abstinence as the most effective method and encouraging its adoption as a healthy lifestyle. Thus, it is expected that these interventions reduce both sexual activity and sexual risk behavior, being focused either on virgin adolescents and those who were sexually active [6,13,14].

The objectives of these educational strategies are to increase adolescents' knowledge, influence attitudes and beliefs, increase protective sexual behaviors (reduce the number of sex partners and unprotected sexual activity, and increase in condom and hormonal contraceptive use), and create supportive norms [6,12]. Although most interventions are provided in school-based programs, they can also be provided in other scenarios, such as community settings (clinics, centers, clubs, summer camps) and at the recipients' home, through remote interventions (e.g., games and online classes; children's simulators). Additionally, the interventions are carried out through different methods, such as expositive classes, games, workshops, debates, role-plays, realistic simulations and may include delivery of educational materials [6,13,15,16]. Modern modalities of educational interventions allied with technological evolution, such as smartphone apps, social networks, digital platforms, text messaging and web-based have already been tested and have shown some positive effect [17-20]. The use of these modalities is interesting as it can reach more vulnerable adolescents

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and be more cost-effective than in-person programs [11,18]. Additionally, digital interventions offer ample opportunities for customization and interactivity for transmitting sexual health knowledge and skills [11].

Within the comprehensive interventions category, exists a wide range of individual programs, each with a different focus and approach, which may reflect in distinct effects. Examples of comprehensive educational programs included: It's your game: Keep it real [21-26]; Reducing the Risk [27,28]; Teen Outreach Program (TOP) [29-31]; Pono Choices [32,33]; Cuídate! [34,35]; Comprehensive Sexuality Education (CSE) [36,37]. Besides the setting, the interventions can be delivered by different providers, such as teachers, trained facilitators, health educators, community leaders, healthcare professionals [16,38]; and the dose of the intervention, represented by the number of contacts established between the provider and the recipient, is also diverse and may impact the benefit found. Thus, it is important to identify the determinants of effectiveness in these prevention programs [6,15,39,40].

One meta-analysis of 43 US Department of Health and Human Services (HHS) funded program evaluations, predominantly focused on sexual health and youth development, examined whether program or participant characteristics were associated with program effects on adolescent sexual risk behaviors and consequences. It was evidenced that gender-specific (girl-only) programs and those with individualized service delivery were more effective. However, the authors emphasize that the evidence is weak since program effects were small and with little variability among them. Additionally, an insignificant

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difference between girl-only programs and those designed for mixed genders was found and the absence of programs targeting exclusively male adolescents does not allow a better comparison [15]. In another overview, parental involvement, inclusion of skills-building (knowledge, attitudes, behavior) and longer term or repeated implementation were common features found in effective interventions provided in high income countries. These features may improve the effect of the intervention through message consistency and reinforcement and by incorporating practical exercises, such as using a contraceptive [41].

There is no single best intervention to prevent pregnancy among adolescents because it is a complex event that depends on sociocultural, environmental and economic factors, such as access to contraceptive methods and to health care services, government policies, cultural context, religion, women's autonomy and decision-making power, family support, social strata and educational level [40, 42-46]. The rate of pregnancy in adolescence is higher in resource-constrained countries, justifying that its incidence is influenced by social disadvantages and inequality [38,43,45]. Thus, it should be noted that no single program model is right for every population and setting, and it is important to exist a variety of programs available for implementation [39].

In this context, some studies have shown that financial incentives such as school uniforms, school subsidies or cash transfers, allied to educational interventions, can be a way of increasing school attendance, by influencing reproductive health, minimizing sexual risk behaviors, and preventing

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adolescent pregnancy. Thus, incentive-based interventions have general protective effects, as they aim to reduce the inequality or economic and social vulnerability of groups with a social gap [38,42, 47-49].

There have been directed efforts at assessing and summarizing the evidence about comprehensive strategies to prevent adolescent pregnancy, especially through systematic reviews [4,6,13,16,38,39,40,42,49-55], which could support further public health policies. These overall education strategies included comprehensive informative approaches about both abstinence and contraception methods aiming at promoting behaviors change towards the prevention or reduction of pregnancy risk.

Studies that evaluated comprehensive interventions assessed their effectiveness considering sexual behaviors, such as delayed onset of sexual activity or use of condoms or other birth control methods (frequency of protected sexual activity) by sexually active adolescents, and biologic outcomes including incidence of pregnancy and STIs.

**Table 1** shows the adopted methods, results and conclusion found in each systematic review/overview that addressed the topic.

Comprehensive approaches that include sexual health education, access to birth control methods, financial incentives, involvement of parents and caregivers, and school-based programs have shown positive results, especially for the intermediate outcomes, such as behavioral changes and improvement of knowledge. However, the effectiveness of these interventions in reducing the

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rates of STIs and pregnancy in adolescence is controversial, not being robust among published studies. The inconsistent and heterogeneous evidence found can be attributed to the mixture of different program types serving different populations of adolescents, some of them presenting favorable results, while others do not. Thus, the best intervention strategy depends on the desired outcome, setting, adolescents characteristics and available resources.

## Abstinence-only interventions

Abstinence education interventions promote abstinence from sexual activity, including delayed onset or abstinence until marriage, teaching the social, psychological, and health benefits by abstaining from sexual activity. In this approach, sexual abstinence is considered the only certain way to avoid pregnancy, STIs and other associated health problems. The use of condoms or other birth control methods are mentioned only to highlight their failure rates or to portray it as a less effective method than abstinence, as it only reduces the risk, while abstinence will eliminate it entirely [6,11,14,56]. Advocates of this approach debate that comprehensive sex education programs send a mixed message about behavior, thereby confusing adolescents, do not possessing a positive effect neither on abstinence nor on condom or other contraceptive use [57].

Thus, the focus of this category is improving knowledge and skills, developing attitudes and intentions to wait to have sex, increasing the number of adolescents who abstain from sexual activity and reducing the health outcomes of pregnancy, HIV, and other STIs [6].

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Authors argue that sexual initiation is considered developmentally appropriate and prolonged abstinence as unrealistic; moreover, adolescents report some barriers of abstinence, including ridicule or teasing from peers, dating partner pressure, and sexual tension. However, abstinent adolescents often cite an ability to refuse sex even feeling pressured, showing behavioral control or self-efficacy to remain abstinent [58].

Few secondary studies focused on assessing abstinence-only education interventions on pregnancy rate or on delay sexual intercourse, and their results were overall inconclusive or showed no significant benefits with this approach, which have been attributed to the scarcity of primary studies, weak designs, and the heterogeneity of program curriculum and their implementation [6,14,40,56,59].

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**Table 2** shows the adopted methods, results and conclusion found in each systematic review that addressed the topic.

Although sexual abstinence may be an effective way to prevent pregnancy STIs, the evidence suggests that intervention programs that exclusively emphasize sexual abstinence are not the best approach to preventing teenage pregnancy. In this way, it seems to be important that these programs include information about contraceptive methods and comprehensive sexual education to provide adolescents with the necessary tools to make healthy and informed decisions about sex.

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## Comparison of comprehensive and abstinence-only interventions

In one study that included 450 African American adolescents aged 12 to 14 years and compared comprehensive and abstinence-only education found that there were no significant differences in recent sexual behavior based on type of sexuality education. However, adolescents who received abstinence-only intervention were more likely to have unprotected sex, showing unfavorable attitudes towards the use of condoms [58]. This finding indicates that interventions that do not cover education about safer sex, may be less effective. It should be noted that actual practice of abstinence often declines with age and it is important to consider the age of adolescents when defining the best intervention approach.

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In another review that compared the two intervention's modalities, comprehensive interventions show positive evidence in delaying sexual initiation or increasing condom use, while abstinence-only interventions are not effective in delaying sexual initiation. Abstinence programs were evaluated in only eight studies; comprehensive interventions were the subject of 48 studies. Furthermore, both groups of programs are very diverse, including abstinence programs more rigid and others that discuss the effectiveness of contraceptives without encouraging their use; and comprehensive programs targeted to younger students focused on abstinence and others targeted older teens sexually active, emphasizing the importance of safe sex [57].

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Besides the scarce and not robust evidence in favor of abstinence-only interventions, participants of these programs consider that they had only a low impact in their lives. Thus, comprehensive sexuality education can play a central role in the preparation of adolescents for a safe and productive life [11].

## Conclusions

This chapter provides the definition of educational interventions and classifies them as soft health technologies, in which structured knowledge is used without the need for high-tech resources. Comprehensive and abstinence-only educational interventions are approaches adopted to reduce sexual risk behaviors and to prevent pregnancy and STIs in adolescence. Based on a review of secondary studies that addressed this topic, it can be concluded that the evidence about the effectiveness of comprehensive interventions is not robust, since the programs are heterogeneous, provided to different populations in distinct settings, which leads to inconsistent results. The evidence about abstinence-only interventions is scarce, weak and have shown no significant benefits in the prevention of pregnancy.

**Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions**

| Study                     | Methods                                                                                                                                                                                                                                                                                                                                                                      | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Chin, 2012 [6]</b>     | This review included randomized controlled trials (RCT) and non-RCT if they presented good quality of execution and were published between 1998 and 2007. The studies included evaluated comprehensive interventions delivered in school or community settings to groups of adolescents.                                                                                     | <p>66 included studies that used a comprehensive risk-reduction strategy. The following outcomes were evaluated:</p> <ul style="list-style-type: none"> <li>• Sexual activity:<br/>OR 0.84 (95% CI 0.75 to 0.95); I2 = 67.7%</li> <li>• Frequency of sexual activity:<br/>OR 0.81 (95% CI 0.72 to 0.90); I2 = 0%</li> <li>• Number of sex partners:<br/>OR 0.83 (95% CI 0.74 to 0.93); I2 = 34.4%</li> <li>• Unprotected sexual activity:<br/>OR 0.70 (95% CI 0.60 to 0.82); I2 = 56.4%</li> <li>• Pregnancy:<br/>OR 0.88 (95% CI 0.60 to 1.30); I2 = 53.3%</li> <li>• STI:<br/>OR 0.65 (95% CI 0.47 to 0.90); I2 = 11.1%</li> </ul> <p>Conclusion: These findings suggest that group-based comprehensive risk reduction is an effective strategy for reducing sexual activity, frequency of sexual activity, unprotected sexual activity and STIs. Concerning pregnancy outcome, the result was not statistically significant and the heterogeneity among the studies was high (I2 statistics &gt; 50%).</p> |
| <b>DiCenso, 2002 [50]</b> | This study included both published and unpublished RCT that evaluated pregnancy prevention programs focused on adolescents (11 to 18 years), such as sex education classes, school-based clinics, family planning clinics, and community-based programs. Additionally, studies that measured the delay in initiation of sexual intercourse, consistent use of birth control, | <p>Twenty-two reports out of 26 RCT evaluated pregnancy prevention programs. The following outcomes were evaluated:</p> <ul style="list-style-type: none"> <li>• Delay in initiation of sexual intercourse:<br/>For girls: OR 1.12 (95% CI 0.96 to 1.30); <math>\chi^2 = 3.4</math><br/>For boys: OR 0.99 (95% CI 0.84 to 1.16); <math>\chi^2 = 12.1</math></li> <li>• Use of birth control during every intercourse:<br/>For girls: OR 0.95 (95% CI 0.69 to 1.30); <math>\chi^2 = 12.8</math><br/>For boys: OR 0.90 (95% CI 0.70 to 1.16); <math>\chi^2 = 0.07</math></li> <li>• Use of birth control during the last intercourse.<br/>For girls: OR 1.05 (95% CI 0.50 to 2.19); <math>\chi^2 = 14.2</math></li> </ul>                                                                                                                                                                                                                                                                                       |

**Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions**

| Study                     | Methods                                                                                                                                                                                                                                                                                                                                                                                                            | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|---------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | or avoidance of unintended pregnancy were included in the analysis.                                                                                                                                                                                                                                                                                                                                                | <p>For boys: OR 1.25 (95% CI 0.99 to 1.59); <math>\chi^2 = 0.1</math></p> <ul style="list-style-type: none"> <li>Pregnancy:</li> </ul> <p>For girls: OR 1.04 (95% CI 0.78 to 1.40); <math>\chi^2 = 14.0</math></p> <ul style="list-style-type: none"> <li>Pregnancy among partners:</li> </ul> <p>For boys: OR 1.54 (95% CI 1.03 to 2.29); <math>\chi^2 = 2.9</math></p> <p><u>Conclusion:</u> Evaluated primary prevention strategies do not delay the initiation of sexual intercourse, improve use of birth control among boys and girls, or reduce the number of pregnancies in adolescence.</p>                                                                                                                                                                                                                                          |
| <b>Estrada, 2021 [38]</b> | This rapid review included RCT published from 2005 to 2019 that evaluated interventions focused on the prevention of first pregnancy among adolescents (10 to 19 years).                                                                                                                                                                                                                                           | <p>Nine studies were included and the evaluated outcome was self-reported pregnancy; for girls, the report of gestation, and for boys, whether they impregnated any girl. Of the nine studies included, three documented an effect in reducing pregnancy, and the other six showed no significant effects in preventing adolescent pregnancy.</p> <p><u>Conclusion:</u> The study found variations in the effectiveness of the interventions based on social context and systems. This implies that while the interventions were designed for the most at-risk adolescents, the success of their implementation depends on other factors. Although interventions targeting vulnerable populations are important, addressing social context and system-level factors are critical to ensure successful implementation.</p>                     |
| <b>Evans, 2020 [51]</b>   | This review included studies published in English that meet several specific requirements. Firstly, it was mandatory to include a sample from the US, with at least 95% of the sample being black and participants being no older than 24 years of age with a mean sample age of $\leq 18$ years. Secondly, the studies had to assess the effects of primary prevention interventions for sexual health, excluding | <p>Twenty-nine studies were included. The following outcomes were evaluated:</p> <ul style="list-style-type: none"> <li>Condom use (26 studies):</li> </ul> <p>Cohen <math>d = 0.25</math> (95% CI 0.11 to 0.39); <math>p &lt; 0.001</math></p> <ul style="list-style-type: none"> <li>Number of sex partners (10 studies):</li> </ul> <p>Cohen <math>d = -0.06</math> (95% CI -0.25 to 0.13); <math>p = 0.54</math></p> <ul style="list-style-type: none"> <li>Pregnancy (4 studies):</li> </ul> <p>Cohen <math>d = -0.16</math> (95% CI -0.41 to 0.09); <math>p = 0.20</math></p> <ul style="list-style-type: none"> <li>STI contraction (4 studies):</li> </ul> <p>Cohen <math>d = -0.07</math> (95% CI -0.43 to 0.30); <math>p = 0.73</math></p> <ul style="list-style-type: none"> <li>Sexual health intentions (14 studies):</li> </ul> |

**Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions**

| Study                     | Methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                    | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|---------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                           | <p>studies that focused on secondary prevention for already pregnant or STI-positive youths. Thirdly, it was imperative to use an experimental or quasi-experimental design to evaluate program effects.</p> <p>Furthermore, the studies had to include at least one of the behavioral or biological outcome measures, such as abstinence, condom, pregnancy, as well as present sufficient statistics to calculate effect sizes.</p>                                      | <p>Cohen <math>d = 0.17</math> (95% CI 0.05 to 0.30); <math>p = 0.007</math></p> <ul style="list-style-type: none"> <li>Sexual health knowledge (11 studies):</li> </ul> <p>Cohen <math>d = 0.46</math> (95% CI 0.30 to 0.63); <math>p &lt; 0.001</math></p> <ul style="list-style-type: none"> <li>Sexual health self-efficacy (15 studies):</li> </ul> <p>Cohen <math>d = 0.19</math> (95% CI 0.09 to 0.28); <math>p &lt; 0.001</math></p> <p><u>Conclusion:</u> Sexual health interventions were significantly associated with improvements in psychological outcomes as sexual health intentions, knowledge, and self-efficacy, while it was found no significant mean association between interventions and number of sex partners, pregnancy, or STI contraction. The findings suggest that sexual health interventions are associated with improvements in sexual well-being among black adolescents. There seems to be a need for wide-scale dissemination of these programs to address racial disparities in sexual health across the US.</p>                                                                                                                                                                                                                       |
| Garzón-Orjuela, 2021 [52] | <p>This overview analyzes systematic reviews and meta-analyses of RCT, cluster-RCT, before-and-after studies, and interrupted and observational time-series studies. The studies targeted sex education interventions for adolescents aged 13 to 18. Educational institutions that implemented sexual education strategies were also considered as participants. The interventions were delivered individually or in groups and specifically focused on sex education.</p> | <p>Thirty-one systematic reviews were included. The key findings indicate that digital interventions are effective in reducing sexual risk behaviors and preventing teenage pregnancy, while theoretical or practical educational interventions have positive effects on associated behaviors, condom use, reduction of sexual partners, and knowledge about HIV and other sexual diseases. Counseling interventions with professionals, teachers, and parents also increase condom use and promote conscious attitudes about sexuality. Other psychosocial interventions and cultural adaptations, such as role-playing techniques and exhibitions, increase adolescent health literacy and promote the use of other contraceptives.</p> <p><u>Conclusion:</u> Interventions promoting the use of condoms, particularly those involving counseling, mass media, technology, and communication and self-care skills, have shown positive results in reducing risk sexual behavior and preventing STIs. However, interventions based solely on the school curriculum showed limited evidence of reducing risky sexual behavior and should be reconsidered in future research. The review emphasizes the importance of understanding the biological, social, cultural, and</p> |

**Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions**

| Study                      | Methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|----------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | contextual development of adolescents in designing effective sexual education interventions, which should involve integral support from the community, including educational and professional support for medical care, culture, and other areas.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                            |
| <b>Goesling, 2014 [39]</b> | This review included RCT and quasi-experimental studies that examined the impacts of programs intending to reduce rates of teen pregnancy, STIs, or associated sexual risk behaviors through any combination of educational, skill-building, and/or psychosocial intervention. The studies had to measure the intervention using quantitative data and statistical analysis and hypothesis testing, and include pregnancy, STIs or sexual risk behaviors outcomes (sex initiation, frequency of sexual. Furthermore, the study sample had to consist of U.S. youth age 19 years or younger at the time of sample enrollment. | <p>A total of 88 studies were included in the review, from which 78 programs were identified. Of this amount, 34 were found to have no evidence of a statistically significant favorable impact. Further, 13 programs showed evidence of a statistically significant impact, but only for a specific endogenous subgroup defined by sexual activity at follow-up. On the other hand, the analysis identified 31 programs that demonstrated evidence of efficacy in reducing teen pregnancy, STIs, or associated sexual risk behaviors. Of the 31 programs, 22 had impacts on a measure of sexual activity, 14 had impacts on a measure of contraceptive use or consistency, five had impacts on STIs, and five had impacts on pregnancies or births. Only one program had impacts on all four categories of outcome measures.</p> <p><u>Conclusion:</u> Out of 78 programs identified in the review, 31 (39.7%) were found to be effective in reducing teen pregnancy, STIs, or associated sexual risk behaviors (sexual activity and contraceptive use or consistency).</p> <p>It is important to note that more research is needed to determine the long-term effectiveness of these programs and to identify strategies for improving the effectiveness of programs with no evidence of a statistically significant favorable impact.</p> |
| <b>Hindin, 2016 [42]</b>   | This study included articles reporting on interventions aimed at preventing early or repeat pregnancy in young people aged 10 to 24 in low- or middle-income countries. The articles were required to be published after 2000 in English, French, Spanish, or Portuguese. This review focused on behavioral outcomes, as changes in knowledge and norms are not necessarily                                                                                                                                                                                                                                                  | <p>A total of 17 studies were included. The following outcomes were evaluated:</p> <ul style="list-style-type: none"> <li>• Pregnancy rates</li> </ul> <p>Out of 16 studies, 6 showed a statistically significant positive impact and a sexual and reproductive health education program in South Africa reported a statistically significant increase in pregnancy. Effective strategies included economic incentives, implementation of education or life skills curriculum as part of a multicomponent campaign, and provision of a contraceptive method.</p> <ul style="list-style-type: none"> <li>• Contraceptive use</li> </ul> <p>Out of 10 studies, seven showed a positive impact, while two studies showed a significant</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

**Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions**

| Study                | Methods                                                                                                                                                                                                                                                                                                                                                                                                                               | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
|----------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      | <p>sufficient to produce behavior change. Studies that did not include behavioral outcomes were excluded from this review.</p>                                                                                                                                                                                                                                                                                                        | <p>decrease in contraceptive use.</p> <ul style="list-style-type: none"> <li>Recent sexual activity</li> </ul> <p>Out of three studies, two demonstrated mixed results (multicomponent intervention and unconditional cash transfer program) and no significant impact was found in the third (education curriculum).</p> <ul style="list-style-type: none"> <li>Age of sexual debut</li> </ul> <p>One intervention had a significant increase in reported age of sexual debut among recipients, while an unconditional cash transfer program showed increased age of sexual debut among females, but not males.</p> <ul style="list-style-type: none"> <li>Abstinence</li> </ul> <p>A single article measuring secondary abstinence as an outcome found no significant impact for a multicomponent intervention.</p> <p><b>Conclusion:</b> The best intervention strategy to prevent unintended or repeat pregnancy among young people depends on the outcome of interest, setting, and resources. Directly providing contraception increases use but is infeasible where health services are inaccessible. Cash transfer programs decrease pregnancy in most settings but may not be resource-efficient.</p> |
| Marseille, 2018 [40] | <p>This study included RCT, prospective and retrospective observational cohorts, serial cross-sectional studies, and other longitudinal analyses published in any language. To be included, studies had to report data from sexual risk reduction programs in the USA or Canada conducted in elementary, middle, or high schools, and report pregnancy risk for the intervention and a control condition (another group or time).</p> | <p>Twenty-one studies were included. The following outcomes were evaluated:</p> <ul style="list-style-type: none"> <li>Pregnancy: <ul style="list-style-type: none"> <li>Follow-up &lt;13 months: RR 0.81 (95% CI 0.61 to 1.09)</li> <li>Follow-up 13–23 months: RR 1.3 (95% CI 1.02 to 1.65)</li> <li>Follow-up 24+ months: RR 0.96 (95% CI 0.81 to 1.13)</li> </ul> </li> <li>Sexual initiation: <ul style="list-style-type: none"> <li>Follow-up &lt;13 months: RR 0.87 (95% CI 0.78–0.97)</li> <li>Follow-up 13–23 months: RR 0.99 (95% CI 0.88 to 1.10)</li> <li>Follow-up 24+ months: RR 0.95 (95% CI 0.90 to 1.01)</li> </ul> </li> <li>No condom use: <ul style="list-style-type: none"> <li>Follow-up &lt;13 months: RR 0.84 (95% CI 0.75 to 0.95)</li> </ul> </li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                             |

**Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions**

| Study                                    | Methods                                                                                                                                                                                                                                                                                                                                                                                                                      | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                                          |                                                                                                                                                                                                                                                                                                                                                                                                                              | <p>Follow-up 13-23 months: RR 1.04 (95% CI 0.92 to 1.18)<br/> Follow-up 24+ months: RR 0.95 (95% CI 0.90 to 1.01)</p> <ul style="list-style-type: none"> <li>Oral contraceptive use:</li> </ul> <p>None of the pooled results showed a statistically significant result when stratified by the three follow-up periods only.</p> <p><u>Conclusion:</u> The included studies provide inconsistent evidence that evaluated programs effectively reduced pregnancy or improved secondary outcomes, as use of contraceptive methods.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
| <p><b>Mason-Jones, 2016</b><br/>[53]</p> | <p>This review included RCT and cluster-RCT that aimed to assess interventions to reduce the risk of HIV/STIs or pregnancy among adolescents (10-19 years) attending primary, middle, or high school. Studies conducted in countries where school enrollment starts at a later age or where school populations may include individuals over 20 years old were included if over 50% of the participants were adolescents.</p> | <p>The analysis included 8 studies that evaluated various clinical/biological and behavioral self-reported outcomes. For each outcome, three comparisons were performed:<br/> Comparison 1: School-based educational interventions versus no intervention.<br/> Comparison 2: Incentive programs versus no intervention.<br/> Comparison 3: Combined incentive and educational programs.</p> <ul style="list-style-type: none"> <li>HIV incidence and prevalence:</li> </ul> <p>The trials indicated that there were no statistically significant differences in HIV incidence between the intervention and control groups, and no observable effects on the prevalence of HIV in young women or men, or both sexes combined. These results were consistent across all three comparisons.</p> <ul style="list-style-type: none"> <li>Other STIs:</li> </ul> <p>Comparison 1: the trials did not find any significant effects on HSV2 or syphilis prevalence in young men or women in the school-based educational interventions group compared to the control group.<br/> Comparison 2: one trial reported a reduction in HSV2 prevalence in young women in the incentive programs group compared to the control group, but it is important to note that the authors did not measure or report HSV2 prevalence at baseline. On the other hand, another trial did not find any effect. In both trials, the prevalence of syphilis was too low to demonstrate any effects.</p> |

Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions

| Study                | Methods                                                                                                                | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|----------------------|------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                      |                                                                                                                        | <p>Comparison 3: combined incentive and educational programs group had a lower prevalence of herpes simplex virus infection compared to the control group, and this reduction was mainly seen in young women.</p> <ul style="list-style-type: none"> <li>Pregnancy:</li> </ul> <p>Overall, there were no discernible effects on the proportion of young women who became pregnant in the short-term or on the incidence of pregnancy at long-term follow-up, either in individual trials or in all trials combined.</p> <ul style="list-style-type: none"> <li>Self-reported measures of behavior change:</li> </ul> <p>Comparison 1: The trials showed no effect on the number of young people reporting their first sexual intercourse during the trial period or on the proportion of young people using a condom during their first or most recent sexual intercourse.</p> <p>Comparison 2: The trials demonstrated a reduction in the proportion of young people reporting their first sexual intercourse during the trial period, but there was no reduction in the proportion using a condom during their most recent sexual intercourse.</p> <p>Comparison 3: The proportion of young people reporting their sexual debut during the trial was lower in those receiving the intervention, but there was no effect on the proportion of adolescents using a condom during their most recent sexual intercourse.</p> <p><u>Conclusion:</u> There is a need to provide comprehensive sexual and reproductive health interventions for adolescents, including contraception and condoms, and to involve them in decision-making about their health. While schools can be a good place to provide such interventions, curriculum-based educational programs alone may not be effective in reducing risk behaviors and improving health outcomes. Addressing wider issues such as gender norms, sexual exploitation, poverty, and inequality is also important, and incentive-based interventions to keep young people in secondary school should be better investigated.</p> |
| Oringanje, 2016 [54] | This review considered RCT and cluster RCT, where the unit of randomization is the household, community, youth center, | A total of 53 studies were included in this review. For any outcomes, two comparisons were performed using data from two groups: those who received educational interventions, and those who received multiple interventions (combination of educational                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

**Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions**

| Study | Methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                     | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|       | <p>school, classroom, health facility, or faith-based institution, that evaluated interventions designed to increase adolescents' knowledge and attitudes about the risk of unintended pregnancies, promote delay in initiation of sexual intercourse, encourage consistent use of birth control methods, and reduce unintended pregnancies. To be eligible for inclusion in this review, participants had to be male and female adolescents aged 10 years to 19 years.</p> | <p>and contraceptive-promoting interventions).</p> <ul style="list-style-type: none"> <li>• Unintended pregnancy               <ol style="list-style-type: none"> <li>1. Multiple interventions:<br/>RCT: RR 0.66 (95% CI 0.50 to 0.87); <math>I^2 = 3.19\%</math><br/>Cluster-RCT: RR 0.50 (95% CI 0.23 to 1.09); <math>I^2 = 75.19\%</math></li> <li>• Initiation of sexual intercourse                   <ol style="list-style-type: none"> <li>1. Multiple interventions:<br/>RCT: RR 0.99 (95% CI 0.74 to 1.32); <math>I^2 = 78.02\%</math><br/>Cluster-RCT: RR 0.84 (95% CI 0.68 to 1.04); <math>I^2 = 73.14\%</math></li> <li>2. Educational interventions<br/>RR 0.95 (95% CI 0.71 to 1.27); <math>I^2 = 9.37\%</math> <ul style="list-style-type: none"> <li>• Condom use in the last sex                       <ol style="list-style-type: none"> <li>1. Multiple interventions:<br/>RR 1.00 (95% 0.95 to 1.06); <math>I^2 = 0\%</math></li> <li>2. Educational interventions<br/>RR 1.18 (95% 1.06 to 1.32); <math>I^2 = 0\%</math> <ul style="list-style-type: none"> <li>• Consistent condom use                           <ol style="list-style-type: none"> <li>- 1. Multiple interventions:<br/>RR 1.21 (95% 0.95 to 1.54); <math>I^2 = 77\%</math></li> <li>• Consistent contraceptive use                               <ol style="list-style-type: none"> <li>1. Multiple interventions<br/>RR 1.29 (1.06 to 1.59); <math>I^2 = 65.34\%</math></li> <li>• Sexually Transmitted Infections                                   <ol style="list-style-type: none"> <li>1. Multiple interventions<br/>RCT: RR 0.89 (95% CI 0.65 to 1.22); <math>I^2 = 56.58\%</math><br/>Cluster-RCT: RR 0.76 (95% CI 0.27 to 2.14); <math>I^2 = 0\%</math></li> <li>• Childbirth                                       <ol style="list-style-type: none"> <li>1. Multiple interventions</li> </ol> </li> </ol> </li> </ol> </li> </ol> </li> </ul></li></ol> </li> </ul></li></ol> </li> </ol></li></ul> |

Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions

| Study            | Methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
|------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                  |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          | <p>RCT: RR 0.64 (95% 0.52 to 0.79); <math>I^2 = \text{NA}</math><br/> Cluster-RCT: RR 0.76 (95% 0.27 to 2.14); <math>I^2 = 0\%</math><br/> <u>Conclusion</u>: Concomitant use of interventions such as education, skills-building, and promotion of contraception, reduces the risk of unintended pregnancy in adolescents, but offers little evidence about the effects of each of these interventions offered alone. Overall, the evidence remains inconclusive.</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| Ribas, 2021 [49] | <p>This review included articles published between 2000 and 2019 that mention at least one country in Latin America and the Caribbean. The outcomes of interest were adolescent pregnancy or its proximate determinants, such as sexual behavior, contraceptive use, or abortion. Only studies that investigated the correlations between the outcomes of interest and public policies or targeted programs were considered in the analysis. The effects were measured on adolescents aged 10 to 19.</p> | <p>Thirty studies from 14 countries were included, from which were identified four policy or program sectors: conditional cash transfers, education, health, and life skills.</p> <ul style="list-style-type: none"> <li>• Conditional cash transfers</li> </ul> <p>Nine studies explored the relationship between conditional cash transfer policies and adolescent pregnancy or its proxy indicators. The conditional cash transfer program involves a monthly stipend to families, provided if they meet certain conditions related to school attendance, health check-ups and talks, and nutrition. Research indicates varying effects across rural and urban populations, as well as at different stages of the program.</p> <ul style="list-style-type: none"> <li>• Education</li> </ul> <p>A review of 14 papers examined the impact of education-related policies on adolescent pregnancy. Three papers analyzed educational reforms affecting the whole population, while 11 explored specific curriculum taught in controlled settings. Evidence showed that increasing compulsory school hours in Chile and Peru resulted in lower adolescent pregnancy rates, particularly among poor urban adolescents in Chile. Similarly, a reform in Argentina which increased compulsory schooling from 7 to 10 years led to increased enrollment rates and reduced adolescent pregnancy rates. However, five studies found no evidence of lasting behavioral changes resulting from sexual and reproductive health sessions in targeted high schools in Brazil, Chile, Jamaica, and Mexico. One study in Jamaica showed a positive effect on contraceptive use at first intercourse, but this effect did not last. A RCT conducted in Chile found higher pregnancy rates among adolescents not exposed to a sex-education program. Two small-sample studies in Belize and Mexico</p> |

**Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions**

| Study | Methods | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
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|       |         | <p>found positive effects on condom use, but no effect on reported sexual practices or unprotected sexual intercourse. A study in Haiti found a stronger effect on reducing adolescent pregnancy among participants in an integrated approach combining sexual and reproductive health (SRH) sessions with sport activities compared to a stand-alone SRH curriculum. Some larger sexuality education programs in Mexico and Brazil showed increased use of modern contraceptives but had no effect on age neither at first intercourse nor on adolescents' engagement in sexual activities.</p> <ul style="list-style-type: none"> <li>• Health</li> </ul> <p>Five studies examined the impact of health policies on adolescent pregnancy rates, including service delivery, access to abortion, contraception, and HIV prevention. One study on Colombia's sexual and reproductive health policy from 2002 to 2006 found mixed results in reducing adolescent pregnancy rates across locations. Three studies examined the impact of abortion legalization, with mixed results in Mexico City and Uruguay. One study in Paraguay found a correlation between the introduction of outreach clinics and reduced adolescent pregnancy rates, but the causality could not be determined. Overall, this is the only study in the review that attempted to measure the impact of a national health policy on adolescent pregnancy.</p> <ul style="list-style-type: none"> <li>• Life skills</li> </ul> <p>The search found two studies on the Juventud y Empleo program in the Dominican Republic, targeting out-of-school youth. The program included classroom and internship training with socio-emotional skills building, and an impact evaluation found a reduction in teenage pregnancy rates, especially for young and single women and those who were already mothers. This effect was attributed to an increase in youth expectations for the future. However, there was no impact on older cohorts, indicating the need for early intervention in shaping future expectations.</p> <p><u>Conclusion:</u> Conditional cash transfers and compulsory education policies showed the strongest correlation with preventing adolescent pregnancy. Life-skills programs for adolescents are showing promising results. However, evidence from public health</p> |

Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions

| Study                         | Methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
|-------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|                               |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               | policies and programs remains limited.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
| <b>Salam, 2016 [55]</b>       | <p>This review included studies published up to December 2014 that assessed interventions aimed at improving sexual health in the adolescent population, with a focus on sex education, preventing unintended adolescent pregnancy, intimate partner violence, and Female Genital Mutilation/Cutting (FGM). For this review, the adolescent population was defined as aged 11-19 years, and exceptions were made for studies targeting adolescents and youth aged 15-24 years. No limitations were applied to the search start date or geographical settings, and subgroup analysis was carried out where data permitted.</p> | <p>Fifty-one studies were included in this overview. The following outcomes were evaluated:</p> <ul style="list-style-type: none"> <li>• Improvement of mean knowledge score about sexual health and contraception: SMD = 2.04 (95% CI 1.31 to 2.78); I<sup>2</sup> = 100%</li> <li>• Use of any contraception: RR = 1.07 (95% CI 1.00 to 1.14); I<sup>2</sup> = 89%</li> <li>• Prevention FGM: RR 0.86 (95% CI 0.75 to 0.99); I<sup>2</sup> = 38%</li> <li>• Improvement of knowledge of harmful consequences of FGM: RR = 1.53 (95% CI 1.08 to 2.16); I<sup>2</sup> = 98%</li> <li>• Pregnancy: RR = 0.85 (95% CI 0.74 to 0.98)</li> <li>• STIs: RR = 1.08 (95% CI 0.79 to 1.46)</li> </ul> <p><u>Conclusion:</u> The effectiveness of sexual and reproductive health education, counseling, and contraceptive availability in increasing adolescent knowledge related to sexual health, contraceptive use, and decreasing adolescent pregnancy was found in this study. Limited and inconclusive evidence was found for the effectiveness of interventions to prevent intimate partner violence. Comprehensive interventions targeting sexual health education, counseling, consistent birth control methods promotion and provision have the potential to prevent and control adverse outcomes related to risky sexual behavior. However, much more is needed to increase awareness and prevent FGM and violence.</p> |
| <b>Sanz-Martos, 2019 [13]</b> | <p>This review included experimental and quasi-experimental studies published in English or Spanish, which evaluated any educational program provided to adolescents (13-19 years) and designed to modify the rate of teenage pregnancies. The comparator was the absence of additional interventions beyond the</p>                                                                                                                                                                                                                                                                                                          | <p>Twenty-four studies were included. The following outcomes were evaluated:</p> <ul style="list-style-type: none"> <li>• Pregnancy rate:<br/>Out of four studies, two found a significant reduction in pregnancy rates, while the other two did not find any significant differences between the intervention and control groups.</li> <li>• Change in the knowledge about sexuality and contraceptive methods:<br/>Of the 13 studies identified, all showed a significant improvement in the participants' level of knowledge.</li> <li>• Change in attitudes:<br/>Out of eight studies, six found a significant change in attitudes towards the use of</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |

**Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions**

| Study            | Methods                                                                                                                                                    | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|                  | existing educational programs available to the population.                                                                                                 | <p>contraceptive methods. Participants showed a greater willingness to use condoms or birth control pills after the intervention. However, two studies did not find statistically significant differences.</p> <ul style="list-style-type: none"> <li>• Development of negotiation skills:</li> </ul> <p>Two studies were identified and in one of them participants showed a significantly greater willingness to negotiate the use of some contraceptive method in future sexual relationships. However, the other one found that there were no statistically significant differences.</p> <ul style="list-style-type: none"> <li>• Modification in the age of onset of sexual relationships:</li> </ul> <p>Out of four studies, one showed a significant increase in the number of participants who decided to abstain from sexual relationships. Another study found a significant increase in participants' willingness to delay the age of onset of sexual relationships. However, two studies did not find statistically significant differences.</p> <ul style="list-style-type: none"> <li>• Modification in the use rate of contraceptive methods:</li> </ul> <p>Out of five studies, four found higher rates of contraceptive method used in participants who received the intervention and only one study did not find statistically significant differences.</p> <p><u>Conclusion:</u> Educational interventions have shown to be effective in improving knowledge level, modifying attitudes, and increasing the use rate of contraceptive methods. However, no statistically significant differences were found. Regarding the other variables included in this review, their effectiveness could not be confirmed, with an equal number of studies showing positive and negative results. Further research using longitudinal methodology is needed to determine whether changes in knowledge level led to changes in behavior for decreasing teenage pregnancy rates.</p> |
| Scher, 2006 [16] | This review aimed to identify RCT that exclusively or primarily included middle and high school-aged youth between 11 and 18 years old, conducted in field | <p>Thirty-one RCTs were included in this review. The results were presented as pooled Impact Estimates, by outcome:</p> <ul style="list-style-type: none"> <li>• Sexual Experience</li> </ul> <p>Intervention group mean: 37.9%</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |

**Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions**

| Study | Methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
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|       | <p>settings in the United States or developed countries with higher than average rates of unplanned teen pregnancy, such as Canada, England, New Zealand, Australia, or Western Europe. The studies must have been reported or published between 1980 and April 2006, and only English-language databases and journals were explored for the selection of the studies. The primary goal of the interventions in these studies was to reduce sexual activity and/or pregnancy risks among non-parenting youth.</p> | <p>Control group mean: 39.1%<br/>90% CI: +/- 1.6%</p> <ul style="list-style-type: none"> <li>• Pregnancy Risk</li> </ul> <p>Intervention group mean: 13.7%<br/>Control group mean: 15.0%<br/>90% CI: +/- 1.7%</p> <ul style="list-style-type: none"> <li>• Pregnancy</li> </ul> <p>Intervention group mean: 8.2%<br/>Control group mean: 8.6%<br/>90% CI: +/- 1.1%</p> <p>The authors conducted an analysis to look within program types, as the overall pooled analysis was significantly heterogeneous. However, this analysis did not find consistent evidence that specific programs or program types evaluated rigorously reduce rates of sexual experience among participants. Although rates of sexual experience varied widely across program types, when looking within intervention types, the rates appeared to be nearly identical for both the treatment and control groups.</p> <p><u>Conclusion:</u> There is no consistent evidence that pregnancy prevention programs can significantly reduce sexual activity or pregnancy risks among youth, despite some estimated impacts. However, this overall finding should not be interpreted as programs does not work, as there are two main reasons for this. Firstly, the overall pooling of studies mixes results of different program types serving different populations of adolescents, and statistical heterogeneity exists because certain studies have significantly larger or smaller effect sizes. Secondly, from a statistical standpoint, the analysis suggests that the null hypothesis cannot be rejected, meaning that there is no evidence that the programs studied work consistently. Therefore, further subgroup analyses are needed to determine the impacts of specific programs or particular adolescents.</p> |

**Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions**

| Study           | Methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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| Tolli, 2012 [4] | <p>This review included studies written in English, German, or Spanish that assessed interventions designed to be implemented by peer educators for the prevention of HIV, adolescent pregnancy, and promotion of sexual health in young people aged between 10 and 24 years in any of the 27 member countries of the European Union. The acceptable comparators for the intervention are no intervention or standard practice. The studies should be evaluated using randomized controlled trials, non-randomized controlled studies, or before-and-after study designs.</p> | <p>Seventeen publications were identified, corresponding to five distinct interventions (some of which were supported by multiple publications).</p> <ul style="list-style-type: none"> <li>• Unintended pregnancy</li> </ul> <p>One intervention evaluated this outcome using sing abortion routine data and live births data, but no significant changes were observed.</p> <ul style="list-style-type: none"> <li>• Sexually transmitted infections</li> </ul> <p>In one intervention that evaluated STIs using self-report, no significant differences were found between the intervention and the control group.</p> <ul style="list-style-type: none"> <li>• Contraception use</li> </ul> <p>Three studies reported results regarding condom use, and none of them found statistically significant effects.</p> <ul style="list-style-type: none"> <li>• Number of sexual partners</li> </ul> <p>One intervention assessed the number of sexual partners and no statistically significant differences between the control group and the experimental group were found.</p> <ul style="list-style-type: none"> <li>• Sexual experience</li> </ul> <p>One of the interventions evaluated the sexual experience, and there was a statistically significant increase in the percentage of students who reported having sexual experience in the intervention group.</p> <ul style="list-style-type: none"> <li>• Knowledge</li> </ul> <p>All the studies included in the analysis evaluated knowledge as an outcome measure, but only one study found statistically significant effects of the intervention. In the other studies, one reported a positive trend towards the intervention group but not statistically significant, two studies found no significant differences between the groups, and one study found that the control group had better results than the intervention group.</p> <ul style="list-style-type: none"> <li>• Communication and negotiation skills</li> </ul> <p>Three studies evaluated the skills of communication and negotiation, and two of them did not find significant differences between the groups. The third study found a trend in favor of the intervention group, but the difference was not statistically significant.</p> |

Table 1. Secondary studies that assessed the effectiveness of comprehensive interventions

| Study | Methods | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
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|       |         | <ul style="list-style-type: none"> <li>• Attitudes</li> </ul> <p>Of the three studies that evaluated attitudes, only one found statistically significant differences in favor of the intervention group, while the other two did not find differences between the intervention and control groups.</p> <ul style="list-style-type: none"> <li>• Behavioral intentions</li> </ul> <p>Only one study evaluated behavioral intentions, specifically the intention to use condoms. However, this study did not find any statistically significant effects of the intervention when compared to the control group.</p> <p><u>Conclusion:</u> Despite some statistically significant and non-significant changes observed in the studies, the overall conclusion is that, when compared to standard practice or no intervention, there is no clear evidence of the effectiveness of peer education in HIV prevention, adolescent pregnancy prevention, and sexual health promotion for young people in the member countries of the European Union. Further research is needed to determine the factors that contribute to the effectiveness of the program.</p> |

CI = confidence interval; I2 = inconsistency index; NA = not applicable; OR = odds ratio; RCT = randomized controlled trial; RR = risk relative; SMD = standard mean difference; STIs = sexually transmitted infections;  $\chi^2$  = chi-squared test

**Table 2. Secondary studies that assessed the effectiveness of abstinence-only interventions**

| Study                       | Methods                                                                                                                                                                                                                                                                                  | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |
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| <b>Chin, 2012 [6]</b>       | This review included randomized controlled trials (RCT) and non-RCT if they presented good quality of execution and were published between 1998 and 2007. The studies included evaluated comprehensive interventions delivered in school or community settings to groups of adolescents. | <p>Twenty-three studies (27 study arms) that used an abstinence education intervention approach were included. The following outcomes were evaluated:</p> <ul style="list-style-type: none"> <li>• Sexual activity:<br/>OR 0.81 (95% CI 0.70 to 0.94); I<sup>2</sup> = 57.3%</li> <li>• Frequency of sexual activity:<br/>OR 0.77 (95% CI 0.57 to 1.04); I<sup>2</sup> = 62.7%</li> <li>• Number of sex partners:<br/>OR 0.96 (95% CI 0.83 to 1.11); I<sup>2</sup> = 13.3%</li> <li>• Unprotected sexual activity:<br/>OR 1.07 (95% CI 0.86 to 1.33); I<sup>2</sup> = 0.0%</li> <li>• Protection:<br/>OR 1.06 (95% CI 0.96 to 1.17); I<sup>2</sup> = 0.0%</li> <li>• Pregnancy:<br/>OR 1.15 (95% CI 1.00 to 1.32); I<sup>2</sup> = 1.02%</li> <li>• STIs:<br/>OR 1.08 (95% CI 0.90 to 1.29); I<sup>2</sup> = 21.8%</li> </ul> <p><u>Conclusion:</u> Abstinence education interventions show a favorable effect on reducing sexual activity and frequency of sexual activity. However, the results varied significantly when stratified by study design. The effect estimates for pregnancy and STIs were unfavorable, with significant reduction observed only for pregnancy. The study also found that the secondary outcomes of abstinence education, such as the number of sexual partners, unprotected sexual activity, and use of protection during sexual activity, did not show any significant effect. The study emphasizes the importance of considering study design when interpreting the results of abstinence education interventions.</p> |
| <b>Marseille, 2018 [40]</b> | This study included RCT, prospective and retrospective observational cohorts, serial cross-sectional studies, and other longitudinal analyses reporting data from                                                                                                                        | <p>Two of the included studies evaluated abstinence-only programs, and the following outcome was analyzed:</p> <ul style="list-style-type: none"> <li>• Pregnancy incidence:<br/>RR 1.15 (95% CI 0.36 to 3.67).</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |

**Table 2. Secondary studies that assessed the effectiveness of abstinence-only interventions**

| Study                   | Methods                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
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|                         | sexual risk reduction programs in the USA or Canada (elementary, middle, or high schools).                                                                                                                                                                                                                                                                                                                                                                                                                                          | <u>Conclusion:</u> The effectiveness of abstinence-only interventions is still debated, and future studies may reveal different outcomes than those currently reported in the literature.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| <b>Rotz, 2020 [56]</b>  | This review selected longitudinal studies and "quasi-experimental" studies published from 2000 to 2018 and conducted exclusively in the United States. Studies that focused on delayed sexual activity as the main predictor variable of interest were initially chosen. Studies that used delayed sexual activity as the only one of many control variables and were therefore unlikely to provide rigorous evidence on cause-and-effect relationships between delayed sexual activity and the outcomes of interest were excluded. | Fifty-seven studies were included. Evidence of relationships between delayed sexual initiation and both pregnancy and STI transmission was found in the study. Additionally, effects within the domains of relationships, high school graduation, and mental health were also found. However, outcomes related to delinquency and criminal activity, risky sexual behavior, and substance use were found to be less definitive in the research examined.<br><u>Conclusion:</u> Delaying sexual activity can have various benefits, such as reducing the chances of becoming pregnant as a teenager and decreasing the risk of contracting STIs. Delaying sexual activity can also have non-physical effects, such as affecting a future romantic partnering and improving mental health outcomes. However, the interpretation of the results can be affected by differences in how sexual activity is defined and measured. While delayed sexual activity has been found to be correlated with certain negative outcomes, such as delinquency and substance abuse, more research is needed to establish causal pathways. |
| <b>Silva, 2002 [14]</b> | To be included in this review, interventions had to target normal adolescent populations in public or private schools in the USA and report on measures of abstinent behavior, such as delayed onset of intercourse, reduced frequency of intercourse, or reduced number of sexual partners. The study design had to be experimental or quasi-experimental. Additionally, the presence of an independent and comparable 'no                                                                                                         | Twelve studies were included in the review. Several factors such as parental participation, age of participants, virgin-status of the sample, grade level, percentage of females, scope of implementation, and year of publication were found to be associated with variations in effect sizes for abstinent behavior in univariate tests. The overall effect size for abstinent behavior was very small and not significantly associated with the type of intervention used in sex education programs, whether they were abstinence-oriented or comprehensive. However, two moderators, parental participation, and percentage of females, were found to be significant in both univariate and multivariable tests.<br><u>Conclusion:</u> While parental participation in sex education programs appeared to be associated with higher effect sizes in abstinent behavior, further exploration is needed because only a small number of studies have reported success in involving parents.                                                                                                                             |

**Table 2. Secondary studies that assessed the effectiveness of abstinence-only interventions**

| Study                       | Methods                                                                                                                                                                                                                                                                                                                 | Results and conclusions                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                    |
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|                             | intervention' control group was required, and studies had to be published between January 1985 and July 2000. The review synthesized findings from controlled sex education interventions that reported on abstinent behavior.                                                                                          | Interventions geared towards younger students, predominantly females, and those who had not yet initiated sexual activity appeared to be more effective, and smaller-scale interventions were found to be more successful than larger programs. More efforts should be directed towards conducting RCT and measuring intervening variables, as well as providing detailed reporting of results to improve the quality of research in sex education.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| <b>Underhill, 2007 [59]</b> | This study included randomized and quasi-randomized controlled trials of sexual abstinence-only interventions for pregnancy and HIV prevention and only HIV prevention, in high-income countries. Interventions were any efforts to encourage sexual abstinence as the exclusive means of HIV and pregnancy prevention. | <p>Thirteen RCT were included. The following outcomes were evaluated:</p> <ul style="list-style-type: none"> <li>• Biological outcomes</li> </ul> <p>Abstinence-only programs for preventing STIs were ineffective in several trials, with no significant short-term or long-term benefits observed, and one trial even reported adverse effects. The reasons for the lack of effectiveness are unclear and long-term adverse effects did not correspond to significant changes in sexual behavior. None of the eight trials that assessed self-reported pregnancy found a significant benefit compared with usual care.</p> <ul style="list-style-type: none"> <li>• Behavioral outcomes</li> </ul> <p>Seven trials assessed the incidence of any vaginal sex, with only one trial finding a protective effect at two months' follow-up compared to usual care. Four trials assessed the frequency of vaginal sex (no protective effect). Eight trials assessed the number of sex partners (no significant effect). Nine trials assessed condom use (no significant effect). Ten trials assessed incidence of sexual initiation (no significant effect compared to usual care or non-enhanced program versions). One trial using a sexual behavior index found no significant effect for an abstinence-only program compared to a non-enhanced program version and no treatment.</p> <p><u>Conclusion:</u> Abstinence-only programs are not an effective strategy for preventing HIV infection or pregnancy. These programs do not appear to promote abstinent behavior nor decrease sexual activity.</p> |

CI = confidence interval; I<sup>2</sup> = inconsistency index; OR = odds ratio; RCT = randomized controlled trial; RR = risk relative; STIs = sexually transmitted infection

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## Abstract

Adolescent pregnancy is associated with health, social and economic burdens. Different strategies have been implemented to prevent this outcome; yet few updated data on their effectiveness exist. We aim to synthesize the available evidence on the impact of interventions to delay sexual activity onset in adolescents by means of a broader systematic review. A literature search to gather interventional and observational analytical studies published since 2010 was conducted in PubMed, Scopus, PsycINFO, CINAHL Plus, ERIC and LILACS, being complemented by grey literature and manual searches. A total of 57 studies were identified reporting data on 60 comprehensive and 9 abstinence-only interventions. The interventions were predominantly provided in schools (69.6%), in person (82.6%), and in groups (66.7%), by trained facilitators or educators (43.5%). The recipient of the intervention was exclusively the adolescent in 85.5% of the studies. Five out of 9 abstinence-only interventions presented a statistically favorable result towards the use of the intervention for any of the evaluated outcomes (delay/intention to delay sexual intercourse and pregnancy; this rate was of 22 from the 60 comprehensive interventions. Most intervention components had similar effect as the comparator group (no statistical differences) or data was limited to reach any conclusion. This review showed a scarcity and low-quality evidence on the effectiveness of abstinence-only interventions, and the absence of robust evidence for comprehensive strategies aiming at delaying sexual practice by adolescents to avoid early pregnancy. Further well-designed and well-reported studies are needed to help stakeholders to understand this scenario and enable decision-making process within public policies for this population.

**Keywords:** adolescent; pregnancy; prevention; systematic review.

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## Introduction

Pregnancy in adolescence is a global public health problem especially in low- and middle-income countries [1], where around 21 million girls aged 15–19 years become pregnant each year, with approximately 12 million of them give birth [2]. As reported in Chapter 1, unintended pregnancies among adolescents result in health, social, and economic burdens to both individuals, families, and communities [1], and sociocultural, economic, individual, and health service-related factors can be associated to this phenomenon [3].

There is a variety of strategies to prevent adolescent pregnancy, such as school-based intervention/workshops, health services/counseling, communications/media outreach, peer education, and even cash transfer [4]. Educational interventions are considered soft technologies and can be categorized according to their effects on adolescent behavior, such as increased level of knowledge and attitudes relating to risks of adolescence pregnancies, delay in initiation of sexual intercourse, consistent use of birth control methods, and reduction in unintended pregnancies [5-6].

As described in Chapter 2, some systematic reviews that evaluate the effectiveness of interventions for prevention of pregnancy in adolescence have

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already been published [5-22], most of them restricted to comprehensive education strategies or including studies from specific countries or world regions (i.e., low- and middle-income countries [8], high-income countries [18], United States of America [12,19,21,22], United States of America and Canada [10], European countries [15], Latin America and Caribbean [20]). Few studies focused on assessing abstinence-only interventions on pregnancy rate or on delay sexual intercourse, and their results were overall inconclusive or showed no significant benefits with this approach [10-11; 18; 21-23].

Thus, this study aimed to evaluate and update the evidence on the effectiveness of strategies to delay sexual activity onset to prevent pregnancy in adolescents by means of a broader systematic review.

## Methods

This systematic review followed the Cochrane Handbook for Systematic Reviews of Interventions [24] and the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 checklist to guide the study' conduction and report [25]. The protocol was registered on the International Prospective Register of Systematic Reviews (PROSPERO) - CRD42022312097

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## © *Search strategy and eligibility criteria*

A comprehensive literature search was conducted to identify relevant studies published between 1st January 2010 to our search date of 15th February 2022, in PubMed, Scopus, PsycINFO, CINAHL Plus, Educational Resources Information Center (ERIC) and Latin American and Caribbean Health Sciences Literature (LILACS). A grey literature search was additionally performed in Google Scholar (up to the 100 records, excluding patents and citations) to identify studies not indexed in the above-mentioned databases. Manual searches in the Google.com website using a combination of subject terms (e.g., population and outcomes) and advanced search operator “filetype:pdf”, and in the reference lists of the included studies were performed. See full strategies in Appendix 1.

This review included studies meeting the following criteria: 1) involved adolescents and-or young adults according to the author’s definition; 2) evaluated any educational intervention focusing on adolescents and-or young adults, parents and other health professionals, implemented at an individual or

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collective level, to delay the onset of sexual activity by adolescents, intention to delay sexual activity, and incidence of pregnancy; 3) studies without a comparator group or with a comparator of any type, including participants without exposure to the educational intervention (comprehensive or abstinence-only) and participants exposed to different interventions or doses of the same intervention (different number of contacts during care or duration of intervention); 4) interventional studies (randomized and non-randomized controlled trials, quasi-experimental trials) or observational analytical studies (cohort, case-control, cross-sectional study). Studies that involved children or adults, according to author's definition, evaluated different outcomes than those above-mentioned, published in non-Roman characters and publication designed as reviews, letters, surveys, comments, and case series were excluded.

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## ⊙ *Study selection and data extraction*

Studies retrieved from the databases were allocated into Rayyan, a web application for screening and selecting studies [26]. Based on the defined eligibility criteria, two groups of independent reviewers (B.D.F, A.T.R., D.S.K. and I.P.M) performed the screening of titles and abstracts (Phase 1) and subsequent reading of the full texts (Phase 2). Disagreements were resolved by consensus or, if necessary, by two other reviewers (I.R. and T.M.L.).

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Data extraction was carried out by four researchers (B.D.F, A.T.R., D.S.K. and I.P.M), and verification was carried out by two other independent researchers (I.R. and M.A.C.). Disagreements were resolved through consensus. A data extraction form was prepared and previously tested using the Microsoft Excel 2013 sheets. The following data were collected from the included studies: meta-data (author, year of publication, country, funding statement, study design, sample size); characteristics of the respondent population (sex and age) and the outcomes of interest. Intervention components were also collected: characteristics of intervention and control programs (name, detailed description, and program content); intervention delivery strategies (method and type of contact, setting, number of contacts, provider, and intervention target population).

The type of educational intervention was classified into (i) abstinence-oriented, if the explicit aim was to encourage the delay of sexual intercourse as the primary method to reduce pregnancy, or (ii) comprehensive intervention, if it suggests abstinence as the preferred method to reduce the risk of pregnancy but provide orientation about strategies to sexual risk-reduction as the use of contraceptives.

The outcomes of interest were behavioral (i.e., related to delay or intention to delay sexual intercourse), and clinical (i.e., evaluated pregnancy). It is

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important to note that the outcomes were presented according to the measures used in the studies or reports, such as questionnaires, scales, and self-reports. For "delay in sexual intercourse", measures of having sexual intercourse, age at first sexual intercourse, or abstinence (i.e., when the population had never had sex at baseline) were considered. For the outcome "intention to delay sexual intercourse", measures of intentions, perceptions, beliefs, attitudes and plans to have sex or abstain were considered. In cases of studies reporting sexual activity as both vaginal, oral and anal intercourses, only vaginal intercourse data was considered as previous literature estimates that for 80% of adolescents the age at first vaginal intercourse captures the age of first oral or anal intercourses [21].

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Interventions were categorized for each outcome based on the inference statistical analysis: statistically significant benefit in favor of intervention, statistically significant benefit in favor of control, indifferent for compared groups, and without statistical analysis.

## ⊙ *Risk of bias and quality assessment*

The risk of bias in the included randomized controlled trials was assessed using version 2 of the Cochrane risk-of-bias tool for randomized trials (RoB 2), employing the guidance and additional version for cluster-randomized trials. The RoB 2 tool includes five domains that cover all types of bias that can affect

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the results of randomized trials: bias arising from the randomization process (D1); bias due to deviations from intended interventions (D2); bias due to missing outcome data (D3); bias in measurement of the outcome (D4); and bias in selection of the reported result (D5) [24]. In addition to the specific guidelines for assessing the risk of bias in cluster randomized trials, the D1 of this variant also includes the assessment of bias arising from the timing of identification and recruitment of participants [24]. The overall 'Risk of bias' judgment (low; high; some concerns) for each specific outcome was determined by the highest level of judgment in any of the domains that were assessed [24].

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The risk of bias of non-randomized interventional studies and analytical observational studies was assessed using the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool. The domains bias due to confounding; bias in selection of participants into the study; bias in classification of interventions; bias due to deviations from intended interventions; bias due to missing data; bias in measurement of the outcome, and selection of the reported result were evaluated. The overall judgment of 'Risk of bias' (low; moderate; serious; critical) for each specific outcome was also determined by the highest level of judgment in any of the domains assessed [24].

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Quality assessment of cross-sectional studies was performed using the adapted Newcastle-Ottawa Scale (NOS), an instrument of up to a maximum of nine points for the least risk of bias in three domains: 1) selection of study groups (four points); 2) comparability of groups (two points); and 3) ascertainment of exposure and outcomes (three points) for case-control and cohort studies. Studies with NOS scores 0–3, 4–6 and 7–9 were considered as low, moderate and high quality, respectively [27].

The risk of bias assessment was conducted by pairs of independent reviewers (B.D.F, A.T.R., M.A.C. and I.P.M), and supporting information and justifications for judgments were recorded. Conflicts were resolved by consensus or, if necessary, by two other reviewers (I.R. and T.M.L.).

## ⊙ *Evidence synthesis*

Descriptive statistics were used to summarize the findings. Individual results of the studies (intervention and control groups) and the effect measures were presented as reported by authors. Outcomes measured were presented in frequency, mean score (standard deviation - SD), mean difference, adjusted odds ratio (AOR), adjusted relative risk (ARR), average treatment effect (ATE), hazard ratio (HR), odds ratio (OR), person years at risk (PYAR) and relative risk (RR). The confidence interval (CI) was also collected as well as the level of statistical

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significance when reported by the authors. When outcomes were measured more than once during the study (different follow-up times), the last measure was considered (i.e., analytical purposes).

## Results

### ⊙ *Characteristics of the included studies*

A total of 7,161 records were retrieved through the electronic search after removing duplicates. Of these, 43 studies met the inclusion criteria and were included in this systematic review. Additionally, 14 registries were recovered by manual search, totalizing 57 included studies [28-84]. See flowchart in **Figure 1**. The references for excluded studies, with the reasons for their exclusion, are available in Appendix 2.

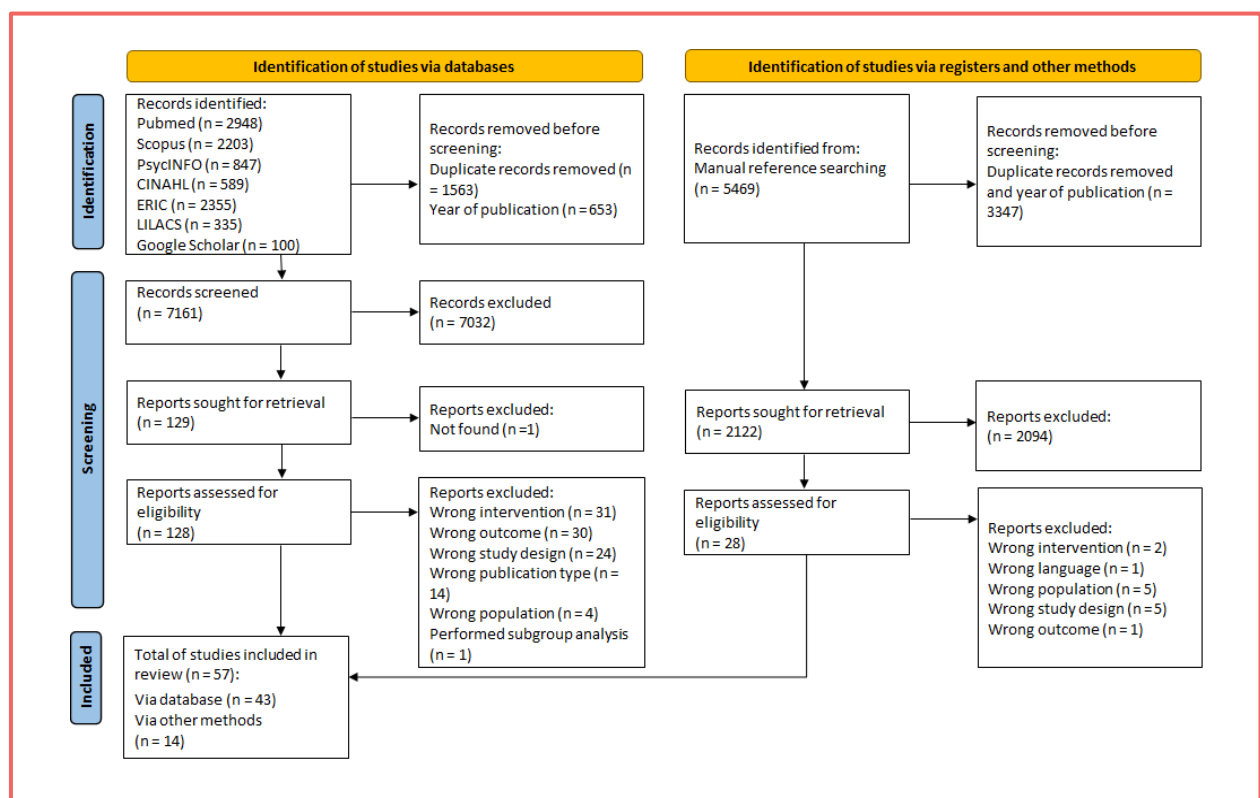
Of the 57 included studies, 52 (91.2%) had an interventional design, mostly randomized controlled trials (n = 41; 71.9%) and 5 (8.8%) were observational studies. Most studies were conducted in the United States (n = 40; 70.2%), followed by African countries (n = 10; 17.5%). The age of adolescents varied from 10 to 19 years and the grade at school from 4 to 12th. Educational interventions provided only for girls were reported in few studies (n = 4; 7.0%); 14 publications (24.6%) were focused on social or ethnic minorities, including African American,

# EFFECTIVENESS OF STRATEGIES TO DELAY SEXUAL ACTIVITY ONSET TO PREVENT PREGNANCY IN THE ADOLESCENCE: A SYSTEMATIC REVIEW

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native, rural, or indigenous adolescents. Sources of funding were declared in 49 (86.0%) studies (see **Table 1**). Appendix 3 provides the detailed description of studies interventions and sources of funding.



**Figure 1.** Flowchart of the study selection process

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Overall, 69 interventions were identified, with comprehensive approaches (including orientations on sexual and reproductive health and over the benefits of contraceptive use and delay of sexual activity onset) the most prevalent (n = 60; 87.0%). Only 9 (13.0%) interventions were abstinence oriented. The components of the interventions included classes, debates, workshops, dramatizations, games, role plays and use of diaries. The most evaluated programs were “It’s your game: keep it real” and its adaptations (n = 6; 8.7%), “Teen Outreach Programme (TOP)” (n = 4; 5.8%), “Cuídate!” (n = 3; 4.3%) and “Comprehensive Sexuality Education (CSE)” (n = 3; 4.3%). Follow-ups ranged from post-intervention assessment to 84 months, with most studies having only one follow-up period.

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**Table 1. Characteristics of included studies**

| Study                      | Country  | Design                        | N                  | Age mean (SD)                                                                | % Female                                      | Minority         | Intervention | Comparator | Outcomes            | Quality                                                                      |
|----------------------------|----------|-------------------------------|--------------------|------------------------------------------------------------------------------|-----------------------------------------------|------------------|--------------|------------|---------------------|------------------------------------------------------------------------------|
| ____, 2011                 | USA      | RCT                           | 1870               | I: 14.4<br>C: NR                                                             | NR                                            | Latino           | COM          | NR         | DSI PREG            | DSI: High <sup>a</sup><br>PREG: High <sup>a</sup>                            |
| Abe et al., 2016           | USA      | Cluster RCT                   | I: 1135<br>C: 600  | I: 12.27 (0.64)<br>C: 12.28 (0.60)                                           | mean (SD)<br>I: 0.53 (0.50)<br>C: 0.55 (0.50) | Native Hawaiian  | COM          | Usual care | DSI<br>IDSI         | DSI: High <sup>b</sup><br>IDSI: High <sup>b</sup>                            |
| Akintobi et al., 2011      | USA      | Cohort                        | 323                | 14.5                                                                         | I: 55.7                                       | African American | ABS          | NR         | DSI<br>IDSI         | DSI: Serious <sup>c</sup><br>IDSI: Serious <sup>c</sup>                      |
| Bailey & Wolf, 2015        | USA      | Pre-post test                 | 115                | 12-18 y                                                                      | NR                                            | No               | ABS          | Usual care | IDSI                | IDSI: Critical <sup>c</sup>                                                  |
| Barbee et al., 2016        | USA      | Cluster RCT                   | I: 481<br>C: 413   | I: 15.77<br>C: 15.71                                                         | I: 63.60<br>C: 62.27                          | No               | COM          | COM        | DSI                 | DSI: Some concerns <sup>b</sup>                                              |
|                            |          |                               | I: 484             | I: 15.69                                                                     | I: 64.32                                      |                  | COM          |            |                     |                                                                              |
| Benton et al., 2011        | USA      | Quasi-experimental (pre-post) | I: 44<br>C: 44     | I: 13.83 (0.38)<br>C: 13.99 (0.47)                                           | I: 61<br>C: 61                                | No               | ABS          | COM        | IDSI                | IDSI: Serious <sup>c</sup>                                                   |
| Campero et al., 2011       | Mexico   | Quasi-experimental (pre-post) | I: 320<br>C: 651   | I:<br>M: 15.2 (0.6)<br>F: 15.1 (0.6)<br>C:<br>M: 15.3 (0.9)<br>F: 15.2 (0.6) | I: 53.40<br>C: 61.10                          | No               | COM          | COM        | DSI                 | DSI: Serious <sup>c</sup>                                                    |
| Chambers et al., 2014      | USA      | Quasi-experimental (pre-post) | 390                | I: 15 - 19 y                                                                 | I: 53                                         | No               | COM          | NR         | DSI<br>IDSI         | DSI: Serious <sup>c</sup><br>IDSI: Serious <sup>c</sup>                      |
| Chokprajakhad et al., 2019 | Thailand | RCT                           | I: 41<br>C: 39     | I: 11 - 13 y<br>C: 11 - 13 y                                                 | NR                                            | No               | COM          | ABS        | IDSI                | IDSI: High <sup>a</sup>                                                      |
| Coyle et al., 2019         | USA      | Cluster RCT                   | I: 528<br>C: 383   | I: 12.35<br>C: 12.42                                                         | I: 51.1;<br>C: 49.9                           | No               | COM          | Usual care | DSI<br>IDSI         | DSI: High <sup>b</sup><br>IDSI: High <sup>b</sup>                            |
| Coyle et al., 2021         | USA      | Cluster RCT                   | I: 903<br>C: 831   | I: 15.3 (0.63)<br>C: 15.3 (0.60)                                             | I: 57.60<br>C: 49.70                          | No               | COM          | COM        | DSI                 | DSI: High <sup>b</sup>                                                       |
| Daley et al., 2019         | USA      | Cluster RCT                   | I: 1744<br>C: 2092 | NR                                                                           | I: 47.80<br>C: 50.40                          | No               | COM          | Usual care | DSI<br>IDSI<br>PREG | DSI: High <sup>b</sup><br>IDSI: High <sup>b</sup><br>PREG: High <sup>b</sup> |

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**Table 1. Characteristics of included studies**

| Study                            | Country  | Design                        | N                       | Age mean (SD)                                                                       | % Female                           | Minority               | Intervention | Comparator | Outcomes    | Quality                                                  |
|----------------------------------|----------|-------------------------------|-------------------------|-------------------------------------------------------------------------------------|------------------------------------|------------------------|--------------|------------|-------------|----------------------------------------------------------|
| Duflo et al., 2015               | Kenya    | Cluster RCT                   | 19289                   | I:<br>F: 13.12 (0.64)<br>M: 13.72 (0.69)<br>C:<br>F: 13.14 (0.6)<br>M: 13.77 (0.66) | I: 28.8 (15.3)<br>C: 29.4 (14.0)   | No                     | ABS<br>COM   | Usual care | DSI<br>PREG | DSI: High <sup>b</sup><br>PREG: High <sup>b</sup>        |
| Erkut et al., 2013               | USA      | Cluster RCT                   | I:708<br>C: 525         | I: 12.81 (0.57)<br>C: 12.99 (0.60)                                                  | I: 59.7<br>C: 40.3                 | No                     | COM          | Usual care | DSI         | DSI: High <sup>b</sup>                                   |
| Fiellin et al., 2016             | USA      | RCT                           | I: 166<br>C: 167        | I: 12.9 (1.1)<br>C: 12.9 (1.1)                                                      | I: 47<br>C: 46.7                   | No                     | COM          | Usual care | DSI<br>IDSI | DSI: High <sup>a</sup><br>IDSI: High <sup>a</sup>        |
| Gelfond et al., 2016             | USA      | Quasi-experimental            | I: 482<br>C: 482        | I: 14.7 (0.6)<br>C: 14.7 (0.6)                                                      | I: 50.8<br>C: 50.8                 | No                     | COM          | Usual care | PREG        | PREG: Serious <sup>c</sup>                               |
| Grossman et al., 2014            | USA      | Cluster RCT                   | I: 1221<br>C: 1231      | I: 13.88 (0.78)<br>C: 14.00 (0.74)                                                  | I: 55<br>C: 48                     | No                     | COM          | Usual care | DSI         | DSI: High <sup>b</sup>                                   |
| Guilamo-Ramos et al., 2011       | USA      | RCT                           | I: 666                  | NR                                                                                  | NR                                 | Latino and black       | COM          | NR         | DSI         | DSI: High <sup>a</sup>                                   |
|                                  |          |                               | I: 679                  |                                                                                     |                                    |                        | COM          |            |             |                                                          |
|                                  |          |                               | I: 671                  |                                                                                     |                                    |                        | COM          |            |             |                                                          |
| Guilamo-Ramos et al., 2020       | USA      | RCT                           | I: 600<br>C: 300        | Mothers:<br>I: 38.6 (8.0)<br>C: 39.3 (9.1)<br>Adolesc: NR                           | Adolescents:<br>I: 55.5<br>C: 58.3 | No                     | COM          | Usual care | DSI         | DSI: High <sup>a</sup>                                   |
| Hagen et al., 2012               | USA      | Quasi-experimental (pre-post) | 293<br>I: 157<br>C: 136 | 12 - 14 y                                                                           | NR                                 | Rural, native American | ABS          | Usual care | DSI PREG    | DSI: Serious <sup>c</sup><br>PREG: Moderate <sup>c</sup> |
| Hattakitpa nichakul et al., 2019 | Thailand | Quasi-experimental (pre-post) | I: 40<br>C: 41          | 10 - 13 y                                                                           | I: 100<br>C: 100                   | Yes - Girls            | ABS          | Usual care | IDSI        | IDSI: Serious <sup>c</sup>                               |
|                                  |          |                               | I: 44                   |                                                                                     | I: 100                             |                        | ABS          |            |             |                                                          |
| Hill et al., 2016                | USA      | Quasi-experimental            | I: 58<br>C: 58          | I: 12.41 (1.0-1.16)<br>C: 12.56 (0.96-1.05)                                         | I: 100<br>C: 100                   | Rural girls            | COM          | Usual care | DSI; IDSI   | DSI: Serious <sup>c</sup><br>IDSI: Serious <sup>c</sup>  |
| Jemmott et al., 2010             | USA      | RCT                           | ABS:134<br>C: 134       | ABS: 12.0 (0.8)<br>C: 12.0 (0.8)                                                    | ABS: 52.2<br>C: 54.5               | African American       | ABS          | Usual care | DSI         | DSI: High <sup>a</sup>                                   |
|                                  |          |                               | COM (8h): 134           | COM (8h): 11.9 (0.8)                                                                | COM (8h): 53.7                     |                        | COM (8h)     |            |             |                                                          |
|                                  |          |                               | COM (12h): 131          | COM (12h): 11.9 (0.8)                                                               | COM (12h): 52.7                    |                        | COM (12h)    |            |             |                                                          |

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| Study                  | Country | Design                        | N                  | Age mean (SD)                                                                                                            | % Female             | Minority        | Intervention | Comparator | Outcomes    | Quality                                           |
|------------------------|---------|-------------------------------|--------------------|--------------------------------------------------------------------------------------------------------------------------|----------------------|-----------------|--------------|------------|-------------|---------------------------------------------------|
| Kangwana et al., 2022  | Kenya   | RCT                           | 2075               | I: 12.6<br>C: NR                                                                                                         | I: 100<br>C: 100     | Girls           | COM          | Usual care | DSI PREG    | DSI: High <sup>a</sup><br>PREG: Low <sup>a</sup>  |
| Kaufman et al., 2014   | USA     | Cluster RCT                   | 635                | I: 12.98<br>C: 13.08                                                                                                     | I: 48.79<br>C: 45.17 | American Indian | COM          | Usual care | DSI         | DSI: High <sup>b</sup>                            |
| Kemigisha et al., 2019 | Uganda  | Cluster RCT                   | I: 476<br>C: 620   | I: 12.2 (1.03)<br>C: 12.1 (1.20)                                                                                         | I: 61.30<br>C: 56.60 | No              | COM          | Usual care | DSI         | DSI: High <sup>b</sup>                            |
| LaChausse 2016         | USA     | Cluster RCT                   | I: 2113<br>C: 1377 | I: 14.63 (0.50)<br>C: 14.63 (0.48)                                                                                       | I: 52<br>C: 56       | No              | COM          | Usual care | DSI<br>PREG | DSI: High <sup>b</sup><br>PREG: High <sup>b</sup> |
| Lieberman et al., 2012 | USA     | Quasi-experimental (pre-post) | I: 896<br>C: 247   | I: 11.0 (0.70)<br>C: 11.5 (0.80)                                                                                         | I: 50.20<br>C: 55.40 | No              | COM          | Usual care | IDSI        | IDSI: Serious <sup>c</sup>                        |
| Lieberman & Su, 2012   | USA     | Cluster RCT                   | I: 754<br>C: 386   | I: 14.2 (0.54)<br>C: 14.19 (0.51)                                                                                        | I: 58.4<br>C: 54.9   | No              | ABS          | Usual care | DSI; IDSI   | DSI: High <sup>b</sup><br>IDSI: High <sup>b</sup> |
| Lohan et al., 2017     | Ireland | Cluster RCT                   | I: 420<br>C: 411   | I: 14.4<br>C: 14.5                                                                                                       | I: 45.24<br>C: 50.61 | No              | COM          | Usual care | DSI         | DSI: High <sup>b</sup>                            |
| Manaseri et al., 2019  | USA     | Cluster RCT                   | I: 997<br>C: 551   | NR                                                                                                                       | NR                   | Native Hawaiian | COM          | Usual care | IDSI        | IDSI: High <sup>b</sup>                           |
| Manlove et al., 2021   | USA     | Cluster RCT                   | I: 294<br>C: 238   | I: 13.85<br>C: 13.86                                                                                                     | I: 53.20<br>C: 49.40 | No              | COM          | COM        | DSI<br>IDSI | DSI: High <sup>b</sup><br>IDSI: High <sup>b</sup> |
| Markham et al., 2012   | USA     | Cluster RCT                   | I: 462<br>C: 435   | I: 12.6 (0.74)<br>C: 12.7 (0.79)                                                                                         | I: 64.1<br>C: 58.8   | No              | COM          | Usual care | DSI<br>IDSI | DSI: High <sup>b</sup><br>IDSI: High <sup>b</sup> |
|                        |         |                               | I: 359             | I: 12.7 (0.73)                                                                                                           | I: 55.3              |                 | COM          |            |             |                                                   |
| Markham et al., 2014   | USA     | Cluster RCT                   | I: 450<br>C: 396   | I: 12.6 (0.76)<br>C: 12.7 (0.81)                                                                                         | I: 62.0<br>C: 59.0   | No              | COM          | Usual care | DSI<br>IDSI | DSI: High <sup>b</sup><br>IDSI: High <sup>b</sup> |
|                        |         |                               | I: 342             | I: 12.7 (0.72)                                                                                                           | I: 57.1              |                 | COM          |            |             |                                                   |
| Maticka-Tyndale, 2010  | Kenya   | Cross sectional               | I: 6874<br>C: 6287 | I:<br>13-15 y: 24.6%<br>16-17 y: 57.4%,<br>18-20 y: 18.1%<br>C:<br>13-15 y: 18.3%,<br>16-17 y: 59.2%,<br>18-20 y: 22.4%. | I: 54.70<br>C: 48.30 | No              | COM          | Usual care | DSI         | DSI: Six stars <sup>d</sup>                       |

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| Study                           | Country | Design                        | N                  | Age mean (SD)                      | % Female             | Minority        | Intervention | Comparator | Outcomes    | Quality                                                 |
|---------------------------------|---------|-------------------------------|--------------------|------------------------------------|----------------------|-----------------|--------------|------------|-------------|---------------------------------------------------------|
| Mmbaga et al., 2017             | Tanzani | Cluster RCT                   | I: 2503<br>C: 2588 | I: 12.39 (0.61)<br>C: 12.43 (0.63) | I: 50.9<br>C: 50.3   | No              | COM          | Usual care | DSI<br>IDSI | DSI: High <sup>b</sup><br>IDSI: High <sup>b</sup>       |
| Morales et al., 2016            | Spain   | Cluster RCT                   | I: 400<br>C: 321   | I: 15.79 (0.79)<br>C: 15.86 (0.91) | I: 51.00<br>C: 52.60 | No              | COM          | NR         | DSI         | DSI: High <sup>b</sup>                                  |
|                                 |         |                               | I: 305             | I: 16.00 (0.95)                    | I: 49.80             |                 | COM          |            |             |                                                         |
| Njue et al., 2015               | Kenya   | Cluster RCT                   | I: 1186<br>C: 1114 | I: 14<br>C: 14.2                   | I: 51<br>C: 52       | No              | COM          | Usual care | DSI         | DSI: High <sup>b</sup>                                  |
|                                 |         |                               | I: 1222            | I: 14.1                            | I: 50                |                 | COM          |            |             |                                                         |
| Oman et al., 2015               | USA     | Quasi-experimental (pre-post) | I: 3244<br>C 3172: | 11 - 14 y                          | I: 49.5<br>C: 48.2   | No              | COM          | ABS        | DSI<br>IDSI | DSI: Serious <sup>c</sup><br>IDSI: Serious <sup>c</sup> |
| Peskin et al., 2015             | USA     | Cluster RCT                   | I: 768<br>C: 606   | I: 14.3 (0.62)<br>C: 14.3 (0.56)   | I: 57.8<br>C: 60.4   | No              | COM          | Usual care | DSI<br>IDSI | DSI: High <sup>b</sup><br>IDSI: High <sup>b</sup>       |
| Peskin et al., 2019             | USA     | Cluster RCT                   | I: 804<br>C: 739   | I: 13.03 (0.57)<br>C: 12.95 (0.56) | I: 55.00<br>C: 54.40 | No              | COM          | Usual care | DSI         | DSI: High <sup>b</sup>                                  |
| Piotrowski-Hedeker, 2016        | USA     | Cluster RCT                   | I: 784<br>C: 671   | I: 11.98 (0.45)<br>C: 23.02 (0.43) | I: 52.0<br>C: 51.70  | No              | COM          | COM        | DSI         | DSI: High <sup>b</sup>                                  |
| Potter et al., 2016             | USA     | Cluster RCT                   | I: 1775<br>C: 1469 | I: 12.7 (0.5)<br>C: 12.8 (0.5)     | I: 54.5<br>C: 51.4   | No              | COM          | Usual care | DSI         | DSI: High <sup>b</sup>                                  |
| Ramírez-Villalobos et al., 2021 | Mexico  | Cluster RCT                   | I: 650<br>C: 555   | 12 - 17 y                          | I: 49.5<br>C: 53.2   | No              | COM          | COM        | DSI         | DSI: High <sup>b</sup>                                  |
| Rijsdijk et al., 2011           | Uganda  | Quasi-experimental (pre-post) | I: 853<br>C: 1011  | I: 16.1 (1.87)<br>C: NR            | I: 55.2<br>C: NR     | No              | COM          | NR         | IDSI        | IDSI: Serious <sup>c</sup>                              |
| Rohrbach et al., 2019           | USA     | Quasi-experimental            | I: 2301<br>C: 2261 | I: 15.0 (0.38)<br>C: 15.1 (0.37)   | I: 49.10<br>C: 49.50 | No              | COM          | Usual care | DSI<br>IDSI | IDSI: Serious <sup>c</sup>                              |
| Robinson et al., 2016           | USA     | RCT                           | I: 1248<br>C: 1180 | I: 13.8 (1.55)<br>C: 13.9 (1.62)   | I: 59.5<br>C: 59.8   | No              | COM          | NR         | DSI         | DSI: High <sup>a</sup>                                  |
|                                 |         | Cluster RCT                   | I: 477<br>C: 347   | I: 12.2 (1.13)<br>C: 12.5 (1.07)   | I: 55.3<br>C: 48.1   |                 |              | COM        |             | DSI: High <sup>b</sup>                                  |
| Rotz et al., 2018               | USA     | Quasi-experimental (pre-post) | I: 977<br>C: 545   | I: 15.0<br>C: 15.4                 | I: 55.4<br>C: 57.2   | No              | COM          | Usual care | DSI         | DSI: Serious <sup>c</sup>                               |
| Shegog et al., 2017             | USA     | Cluster RCT                   | I: 290<br>C: 112   | I: 12.90 (0.98)<br>C: 13.30 (0.86) | I: 56.90<br>C: 51.80 | Native American | COM          | Usual care | IDSI        | IDSI: High <sup>b</sup>                                 |

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| Study                   | Country      | Design          | N                  | Age mean (SD)                                                                                                        | % Female             | Minority        | Intervention | Comparator | Outcomes    | Quality                                           |
|-------------------------|--------------|-----------------|--------------------|----------------------------------------------------------------------------------------------------------------------|----------------------|-----------------|--------------|------------|-------------|---------------------------------------------------|
| Speizer et al., 2020    | South Africa | Cluster RCT     | I: 1477<br>C: 1325 | I: 13.61<br>C: 13.55                                                                                                 | I: 100<br>C: 100     | African Girls   | COM          | NR         | DSI PREG    | DSI: High <sup>b</sup><br>PREG: High <sup>b</sup> |
| Taylor et al., 2014     | South Africa | Cluster RCT     | I: 431<br>C: 385   | I: 14.25 (1.26)<br>C: 14.22 (1.41)                                                                                   | I: 49.4<br>C: 49.9   | No              | COM          | Usual care | DSI<br>IDSI | DSI: High <sup>b</sup><br>IDSI: High <sup>b</sup> |
| Tenkorang et al., 2021  | Gana         | Cross sectional | 2982               | NR                                                                                                                   | 61.03                | No              | COM          | NR         | DSI         | DSI: Six stars <sup>d</sup>                       |
| Tingey et al., 2021     | USA          | RCT             | I: 266<br>C: 268   | I:<br>11-12 y: 38.3%<br>13-14 y: 38.0%<br>15-19 y: 23.7%<br>C:<br>11-12 y: 37.3%<br>13-14 y: 41.0%<br>15-19 y: 21.6% | I: 52.3<br>C: 52.6   | Native American | COM          | Usual care | DSI         | DSI: High <sup>a</sup>                            |
| Tortolero et al., 2010  | USA          | Cluster RCT     | I: 349<br>C: 558   | I: 13.2 (0.57)<br>C: 13.0 (0.51)                                                                                     | I: 60.2<br>C: 58.4   | No              | COM          | Usual care | DSI<br>IDSI | DSI: High <sup>b</sup><br>IDSI: High <sup>b</sup> |
| U.S. HHS Office, 2016   | USA          | Cluster RCT     | 1369               | I: 15<br>C: 15.3                                                                                                     | I: 55.40<br>C: 56.80 | No              | COM          | COM        | DSI         | DSI: High <sup>b</sup>                            |
| Villarruel et al., 2010 | Mexico       | RCT             | I: 394<br>C: 314   | NR                                                                                                                   | NR                   | No              | COM          | Usual care | DSI         | DSI: High <sup>a</sup>                            |
| Walsh-Buhi et al., 2016 | USA          | Cluster RCT     | I: 1947<br>C: 2289 | I:<br><14 y: 62.7%<br>15 y: 23.4%<br>≥16 y: 13.9%;<br>C:<br><14 y: 61%<br>15 y: 25.6%<br>≥16 y: 13.1%                | I: 48.4<br>C: 50.2   | No              | COM          | Usual care | DSI<br>PREG | DSI: High <sup>b</sup><br>PREG: High <sup>b</sup> |
|                         |              |                 | I: 1755<br>C: 1985 | I:<br><14 y: 64.6%<br>15 y: 21.1%<br>≥16 y: 14.3%<br>C:<br><14 y: 62%<br>15 y: 25.3%<br>≥16 y: 13.1%                 | I: 51.5<br>C: 50.8   |                 |              |            |             |                                                   |

a: RoB 2; <sup>b</sup>: RoB 2 for cluster-randomized trials; <sup>c</sup>: Robins-I; <sup>d</sup>: Newcastle-Ottawa Scale; ABS: abstinence-only; C: control; COM: comprehensive; DSI: delay of sexual intercourse; F: female; I: intervention; IDSI: intention to delay of sexual intercourse; M: male; NR: not reported; PREG: reduction of pregnancy; SD: standard deviation; USA; United States of America; y: years. \*Type of intervention: educational intervention was defined as abstinence-oriented if the explicit aim was to encourage the delay of sexual intercourse; comprehensive intervention if it suggests abstinence as the preferred method to reduce the risk of pregnancy but provide orientation.

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For the delay of sexual intercourse outcome (n = 58 interventions having data for this outcome), a statistically significant benefit was found for 17 (29.3%) comprehensive interventions and for 1 (1.7%) abstinence-focused intervention; conversely a non-statistically significant benefit was found for 31 (53.4%) comprehensive interventions and 2 (3.4%) abstinence-only interventions. For the intention to delay of sexual intercourse outcome (n = 26 interventions having data for this outcome), statistically significant benefits were found for 6 (23.1%) comprehensive interventions and 3 (11.5%) abstinence-oriented interventions, while non-statistically significant benefits were reported for 13 (50.0%) and 2 (7.7%) comprehensive and abstinence-only interventions, respectively. The effect of pregnancy reduction was evaluated for 10 (14.5%) interventions, of which only two (1 comprehensive and 1 focused abstinence interventions) led to statistically significant benefits. In 7 out of the remaining 8 interventions, results were indifferent (i.e., no statistical different between groups); for one intervention, result was statistically significant in favor of the control group. Moreover, in one case, the control group was significantly associated with delaying sexual intercourse when compared to a comprehensive intervention. Statistical analyses were absent for 6 (8.7%) interventions. See **Table 2**.

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**Table 2. Results obtained for each outcome**

| Outcome/intervention                                               | N (%)     | References                                                                                                                       |
|--------------------------------------------------------------------|-----------|----------------------------------------------------------------------------------------------------------------------------------|
| <b>Statistically significant benefit in favor of intervention*</b> |           |                                                                                                                                  |
| <i>Delay of sexual intercourse</i>                                 |           |                                                                                                                                  |
| Comprehensive intervention                                         | 17 (24.6) | 32a, 34, 41, 44, 46, 54, 60a, 62, 63, 64, 65a, 65b, 66, 69, 71, 74, 81                                                           |
| Abstinence-only intervention                                       | 1 (1.4)   | 50                                                                                                                               |
| <i>Intention to delay of sexual intercourse</i>                    |           |                                                                                                                                  |
| Comprehensive intervention                                         | 6 (8.7)   | 49, 55, 60a, 72, 74, 78                                                                                                          |
| Abstinence-only intervention                                       | 3 (4.3)   | 31, 48a, 48b                                                                                                                     |
| <i>Reduction of pregnancy</i>                                      |           |                                                                                                                                  |
| Comprehensive intervention                                         | 1 (1.4)   | 39                                                                                                                               |
| Abstinence-only intervention                                       | 1 (1.4)   | 47                                                                                                                               |
| <b>Indifferent for compared groups</b>                             |           |                                                                                                                                  |
| <i>Delay of sexual intercourse</i>                                 |           |                                                                                                                                  |
| Comprehensive intervention                                         | 31 (44.9) | 28, 29, 32b, 37, 38, 39, 42, 45a, 45b, 45c, 50b, 50c, 51, 52, 53, 59, 60b, 61a, 61b, 64, 67, 68, 73a, 73b, 75, 77, 78, 80, 82-84 |
| Abstinence-only intervention                                       | 2 (2.9)   | 40a, 56                                                                                                                          |
| <i>Intention to delay of sexual intercourse</i>                    |           |                                                                                                                                  |
| Comprehensive intervention                                         | 13 (18.8) | 29, 36, 37, 39, 42, 58, 59, 60b, 63, 66, 67, 76, 81                                                                              |
| Abstinence-only intervention                                       | 2 (2.9)   | 33, 56                                                                                                                           |
| <i>Reduction of pregnancy</i>                                      |           |                                                                                                                                  |
| Comprehensive intervention                                         | 6 (8.7)   | 28, 40b, 43, 51, 54, 84                                                                                                          |
| Abstinence-only intervention                                       | 1 (1.4)   | 40a                                                                                                                              |
| <b>Results withouth statistical analyses</b>                       |           |                                                                                                                                  |
| <i>Delay of sexual intercourse</i>                                 |           |                                                                                                                                  |
| Comprehensive intervention                                         | 4 (5.8)   | 35, 49, 57, 79                                                                                                                   |
| Abstinence-only intervention                                       | 2 (2.9)   | 30, 47                                                                                                                           |
| <i>Intention to delay of sexual intercourse</i>                    |           |                                                                                                                                  |
| Comprehensive intervention                                         | 1 (1.4)   | 35                                                                                                                               |
| Abstinence-only intervention                                       | 1 (1.4)   | 30                                                                                                                               |
| <b>Statistically significant benefit in favor of control*</b>      |           |                                                                                                                                  |
| <i>Delay of sexual intercourse</i>                                 |           |                                                                                                                                  |
| Comprehensive intervention                                         | 1 (1.4)   | 70                                                                                                                               |
| <i>Reduction of pregnancy</i>                                      |           |                                                                                                                                  |
| Comprehensive intervention                                         | 1 (1.4)   | 77                                                                                                                               |

\*p value < 0.05 or 95% confidence interval not crossing the nullity line

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By exploring these findings according to the characteristics of studies and target population, it can be observed that in 40% (n = 16) of studies performed in the United States vs. 50% (n = 5) from African countries, interventions were statistically associated with further benefits when compared to controls for some evaluated outcome. Moreover, in 7 studies conducted in other countries, the intervention was statistically significant in 4 (57%) of them. Of the 25 studies showing statistically favorable results towards the use of interventions 15 (60%) were designed as randomized controlled trials and 9 (36%) were quasi-experimental trials. Adolescents' age varied from 10 to 19 years, both in the total sample of the included studies as if considering only those with favorable results towards the intervention. Four (16%) studies focused on social or ethnic minorities, including African American, native and rural adolescents, and two (8%) studies included only girls.

The recipient of the educational interventions was exclusively the adolescent in 85.5% (n = 59) of interventions and both the adolescents and their parents in 8.7% (n = 6). Most of the interventions were provided in groups (n = 46; 66.7%) through face-to-face contacts (n = 57; 82.6%). Interventions were provided both in groups or as individual approach (n = 15; 21.7%) by face-to-face and remote interactions, including telephone, web and games (n = 8; 11.6%). Schools were the most frequent setting for the interventions (n = 48; 69.6%),

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followed by community places (n = 6; 8.7%). Trained facilitators or educators were the most frequent provider of interventions (n = 30; 43.5%), followed by teachers (n = 11; 15.9%). In some studies, the intervention was provided in more than one setting (n = 14; 20.3%) and by more than one provider (n = 15; 21.7%). **Table 3** shows the components of the educational interventions. All data extracted from each study can be found in Appendix 4.

**Table 3. Description of the educational interventions' components**

| Component                                                                  | N (%)      | References                                                                                                                                                                                                                                                    |
|----------------------------------------------------------------------------|------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <i>Recipient of the intervention</i>                                       |            |                                                                                                                                                                                                                                                               |
| Adolescents                                                                | 59 (85.51) | 28, 29, 30, 32a, 32b, 33, 35, 37, 38, 39, 40a, 40b, 41, 42, 43, 44, 45b, 47, 48a, 49, 50a, 50b, 50c, 51, 52, 53, 54, 55, 56, 58, 59, 60a, 60b, 61a, 61b, 62, 63, 64a, 64b, 65a, 65b, 66, 67, 68, 69, 70, 72, 73a, 73b, 74, 75, 76, 77, 78, 79, 80, 81, 83, 84 |
| Adolescents and parents                                                    | 6 (8.70)   | 36, 45a, 45c, 46, 48b, 57                                                                                                                                                                                                                                     |
| Parents                                                                    | 1 (1.45)   | 34                                                                                                                                                                                                                                                            |
| Adolescents, parents, other family members                                 | 1 (1.45)   | 82                                                                                                                                                                                                                                                            |
| Adolescents and teachers                                                   | 1 (1.45)   | 71                                                                                                                                                                                                                                                            |
| Adolescents, parents, caregivers, healthcare professionals, general public | 1 (1.45)   | 31                                                                                                                                                                                                                                                            |
| <i>Contact with recipient</i>                                              |            |                                                                                                                                                                                                                                                               |
| Group                                                                      | 46 (66.67) | 29, 30, 32a, 32b, 33, 34, 35, 37, 38, 40a, 40b, 41, 44, 45b, 47, 48a, 48b, 49, 50a, 50b, 50c, 51, 52, 53, 54, 55, 56, 58, 59, 63, 64a, 64b, 66, 68, 71, 72, 73a, 73b, 74, 75, 77, 78, 80, 82, 83, 84                                                          |
| Individual                                                                 | 5 (7.25)   | 42, 46, 62, 67, 76                                                                                                                                                                                                                                            |
| Group and individual                                                       | 15 (21.74) | 31, 36, 43, 45a, 45c, 57, 60a, 60b, 61a, 61b, 65a, 65b, 69, 70, 81                                                                                                                                                                                            |
| Not reported                                                               | 3 (4.35)   | 28, 39, 79                                                                                                                                                                                                                                                    |
| <i>Method of communication</i>                                             |            |                                                                                                                                                                                                                                                               |

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**Table 3. Description of the educational interventions' components**

|                                                                     |            |                                                                                                                                                                                                                                                        |
|---------------------------------------------------------------------|------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| In person (face-to-face)                                            | 57 (82.61) | 28, 29, 30, 32a, 32b, 33, 34, 35, 37, 38, 39, 40a, 40b, 41, 44, 45b, 47, 48a, 48b, 49, 50a, 50b, 50c, 51, 52, 53, 54, 55, 56, 57, 58, 59, 60a, 60b, 61a, 61b, 63, 64a, 64b, 65a, 65b, 66, 68, 69, 71, 72, 73a, 73b, 74, 75, 77, 78, 80, 81, 82, 83, 84 |
| Remote (telephone, games, web)                                      | 3 (4.35)   | 42, 62, 67                                                                                                                                                                                                                                             |
| In person and remote                                                | 8 (11.59)  | 31, 36, 43, 45a, 45c, 46, 70, 76                                                                                                                                                                                                                       |
| Not reported                                                        | 1 (1.45)   | 79                                                                                                                                                                                                                                                     |
| <b>Setting of the intervention</b>                                  |            |                                                                                                                                                                                                                                                        |
| School and others <sup>a</sup>                                      | 13 (18.84) | 28, 30, 31, 33, 36, 45a, 45c, 47, 57, 65a, 70, 76, 84                                                                                                                                                                                                  |
| Community (health clinic, camp, others)                             | 6 (8.70)   | 32a, 32b, 46, 65b, 73a, 73b                                                                                                                                                                                                                            |
| Recipient's home                                                    | 1 (1.45)   | 42                                                                                                                                                                                                                                                     |
| Community and recipient's home                                      | 1 (1.45)   | 80                                                                                                                                                                                                                                                     |
| <b>Provider of intervention</b>                                     |            |                                                                                                                                                                                                                                                        |
| Trained facilitators, educators, mentors/staff                      | 30 (43.48) | 28, 34, 35, 37, 38, 39, 41, 43, 45a, 45b, 45c, 47, 49, 50a, 50b, 50c, 51, 60a, 60b, 61a, 61b, 64a, 64b, 69, 73a, 73b, 78, 81, 83, 84                                                                                                                   |
| Teachers                                                            | 11 (15.94) | 29, 40a, 40b, 54, 57, 58, 62, 68, 74, 77, 79                                                                                                                                                                                                           |
| Teachers and others <sup>b</sup>                                    | 8 (11.59)  | 36, 56, 63, 65a, 70, 71, 72, 76                                                                                                                                                                                                                        |
| Health educators and others <sup>c</sup>                            | 3 (4.35)   | 31, 33, 65b                                                                                                                                                                                                                                            |
| Health care professionals (nurses)                                  | 2 (2.90)   | 48a, 48b                                                                                                                                                                                                                                               |
| Students (11th and 12th grade and undergraduate university)         | 3 (4.35)   | 53, 75, 82                                                                                                                                                                                                                                             |
| Sexual health educators/health care providers and parents           | 3 (4.35)   | 44, 46, 59                                                                                                                                                                                                                                             |
| Trained community members                                           | 1 (1.45)   | 52                                                                                                                                                                                                                                                     |
| Native paraprofessionals (facilitators) and youth peer-group leader | 1 (1.45)   | 80                                                                                                                                                                                                                                                     |
| Professional actor-educator                                         | 1 (1.45)   | 55                                                                                                                                                                                                                                                     |
| Not reported                                                        | 6 (8.70)   | 30, 32a, 32b, 42, 66, 67                                                                                                                                                                                                                               |

<sup>a</sup> Other settings included recipient's home, community centers, a summer youth employment and sports program, juvenile detention centers and neighborhood settings, club, conferences, summer camps, recreation centers, homeless family shelters, tribal community health centers, tribal boys and girls clubs, after school and summer youth programs.

<sup>b</sup> Other providers of interventions included trained facilitator, staff, educator, community leader, healthcare professional, counselor, college student and wellness coordinator.

<sup>c</sup> Other providers of interventions included community leaders, youth ambassadors, community colleagues and professionally trained social workers.

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## ☉ *Quality assessment of studies*

No study was classified as with high quality. The two cross-sectional studies presented moderate-quality ratings (six points on NOS). For the longitudinal studies with no randomization assessed using the ROBINS-I tool, a total of 19 outcomes were evaluated, of which 17 had a serious risk of bias, 1 had critical risk of bias and 1 moderate risk of bias. From the total of 13 outcomes reported in the randomized trials, 12 had a high risk of bias and only 1 had low risk of bias according to the RoB 2.0 tool. Finally, from the 48 outcomes assessed with the RoB 2.0 tool for cluster randomized trials, only one was evaluated as moderate risk of bias, the remaining were judged as with high risk of bias. Further details about quality assessment is available in Appendix 5.

## Discussion

This systematic review including 57 primary studies provides an updated and comprehensive assessment of the comparative effectiveness of 69 different interventions to delay sexual activity onset aiming at preventing pregnancy in adolescents. Currently, the design and implementation of approaches to reduce first pregnancy in this population is important as although the global adolescent birth rate has declined in the past decades – from 64.5 births per 1000 women in

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2000 to 42.5 births in 2021, rates of change are uneven in different regions of the world, and the actual number of childbirths to adolescents continues to be high (estimation to 15-19-year-olds in 2021 of 6,114,000 cases in sub-Saharan Africa countries) [1]. Yet, we found inconsistent and heterogeneous evidence, with closely balanced benefits (or otherwise) of both comprehensive and abstinence-only interventions, that prevent conclusions over which strategies are more effective in reducing the target outcomes in a given setting.

Although interventions were broadly classified into ‘comprehensive’ or ‘abstinence-only’ for means of comparison, their components were distinct, including different methods of communication and contact with the recipient, setting and intervention provider. Furthermore, the target population was diverse, including adolescents ranging from 10 to 19 years, with different socio-economic and cultural levels. Outcomes were measured through different methods and at different follow-up times. These clinical and methodological heterogeneities between studies prevented the conduction of meta-analyses or other statistical synthesis.

We also found that none of the studies presented high methodological quality or low risk of bias, especially due the unclear description of the interventions and its components (e.g., contact [28,39,79], communication

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method with the recipient [79], intervention provider [30,32,42,66,67], doses of intervention or number of contacts with recipient) [40,51,59,62,65,79], and use of self-reporting measures. Poor and inconsistent description of interventions hamper data interpretation, research reproducibility and implementation of the approach in the real world. To improve research in the area of health interventions, international recommendations advocate the use of tools to guide study's conduction and minimally standard reporting, such as the Template for Intervention Description and Replication (TIDieR) [85].

Although the measurement of pregnancy through lab tests may be more straightforward associated with a given outcome, it may not be feasible in terms of costs and study period for some research [86]. In these cases, the use of self-reporting tools for collecting data is advantageous, especially due its relatively low costs and the ability to collect information from many people (including subjects' perspectives, views, and opinions). Nonetheless, self-reporting measures are associated with several biases that may arise from social desirability, recall period/ memory error, sampling approach, or selective recall [87-88]. To overcome these issues, it is recommended to use instruments with evidence of validity and reliability aiming at reducing response bias and providing more accurate results [89]. However, most of the studies included in this review did not report such instruments or did not properly describe how the

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questionnaires or other self-reporting tools were developed. Moreover, considering that delay sexual activity onset is an outcome that measures time instead of a dichotomous output (yes/no); time-to-event data should be reported – what was the case of only few studies [43,77,79]. Standardized outcomes using ‘sexual intercourse’ as the event, and the ‘age at first intercourse’ or ‘elapsed time between the intervention and first intercourse’ as the time measurement should be used in the future to allow further comparison among studies [90]. Furthermore, statistically significant results obtained in a short follow-up period may not remain on long-term evaluations, justifying the importance of researchers conducting multiple follow-ups to assess the sustainability of the educational intervention – what was not the case of most of included studies. As cited by Goesling et al. [12], future research should consider the best timing for follow-up surveys.

The reduction of pregnancy, the main outcome to assess the effectiveness of the interventions and guide public policies, was measured only in 9 (15.7%) studies. This can be justified by the fact that changes in surrogate outcomes may emerge faster than the real clinical outcome of interest, being required longer-term follow-up to evaluate reduction of pregnancy, especially when the intervention is provided to younger adolescents (10 years) [91]. Moreover, it is more difficult to obtain favorable results for this hard outcome, unlike those

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whose evaluators are the participants themselves, such as the behavioral outcomes [92]. Equally reduced was the number of interventions identified in our systematic review focusing on postponement of sexual activity (n=9; 13%). Although most of these interventions were associated with significant benefits when compared to usual care, one study evaluating an abstinence-only program vs. more comprehensive service-learning approach found no difference between interventions regarding planning to have sex before 20 or before marriage [33]. In addition, the meta-analysis by Chin et al. [11] for abstinence education showed a small number of studies, with inconsistent findings due to study designs and follow-up times, preventing further conclusions about the effectiveness of abstinence-only interventions.

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Most studies did not explore specific reasons why adolescents postpone the onset of sexual activity, not considering whether it was due to conscious choice or lack of opportunities. Since the environment may contribute to the beginning of sexual activity, it can be expected that geographically isolated adolescents have fewer opportunities to engage intercourse than adolescents living in large urban centers. Only two studies [47,49] were conducted in rural settings; none of them performing statistical analyses on the outcomes of interest. Yet, is important to consider that some studies assessed the ‘intention to delay sexual activity’ (i.e., remain abstinent) as an outcome that does relies on subjects’

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opportunity. Our exploratory qualitative analysis shows that individuals from low- and middle-income countries (such as those from Africa) may benefit more from the interventions (i.e., slightly higher percentage of studies presenting favorable results towards the interventions) than those from the United States. Besides the differences among cultures and socio-economic status, another possible explanation for this may be the expansion of mandatory sex education in American schools, which makes it difficult to obtain control groups not exposed to any kind of sex education [22]. Although a greater benefit for delaying the onset of sexual activity is expected when interventions are delivered to younger adolescents (10-13 years), this was not observed in our study, which can be partially justified by the heterogeneity of the population and lack of subgroup analyses according to individuals' age. Few studies were restricted to older adolescents (over 17 years); only one referred to abstinence-focused intervention [31].

Studies included in this review used only a quantitative research approach. However, this approach does not always allow the answer to questions in the education context. A complementary qualitative research approach could enable a deeper understanding of subjects' experiences, adolescent pregnancy phenomena and its context [93]. Tilley claims that critical qualitative research play an important role in informing new directions in

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educational practices and policies [94]. Thus, it is necessary to further evaluate studies using qualitative research approaches as well as encourage researchers to perform more qualitative or mixed methods studies in this context. Evidence is one of the many dimensions that influence decision-making by stakeholders; other dimensions including beliefs, traditions, past experiences, culture, personal interests, and political scenario can also ground public policy development [95]. Previous literature highlighted some barriers for stakeholders' use and translation into practice of the available evidence, which includes lack of access, difficulty in interpreting data and poor reliability of the results, as well as the evidence not always reflecting the local context [96-97]. In this review, most studies were performed in the United States, did not represent the regional experiences and priorities of other regions, especially emerging countries including Brazil. Moreover, it is important to take into consideration other sex educational strategies and the autonomy of the individual to choose (i.e., value-based decision-making).

The strengths of this systematic review are the comprehensive and sensitive literature searches – which reduces the possibility of publication bias [98-99] including a large number of databases explored and additional in grey literature search (where further n=14 [25%] studies were found), and the evidence gap mapping. Previous systematic review on interventions to prevent

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unintended and repeat pregnancy among young people also included 25-30% of grey literature registers [8], probably due low database indexing rates of studies in this field, high prevalence of unpublished material and non-standardized indexing terms used by authors. Despite these strengths, this study has some limitations. Only studies published after 2010 were considered as the goal was to identify more recent evidence on the topic. Due to between-studies heterogeneity and lack of standardized outcome reporting, it was not possible to conduct the meta-analysis.

## Conclusion

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The overall evidence synthesized in this systematic review on the effectiveness of different strategies to delay sexual activity onset to prevent early pregnancy in adolescents was found to be scarce and of low quality for abstinence-only interventions, and uncertain for comprehensive approaches. The variability in study population and delivered interventions and the lack of standardized methods for assessing outcomes preclude further conclusions on the benefits of otherwise of these interventions and its components. Therefore, to help stakeholders to better understand this scenario and enable decision-making process within public policies, further well-designed and well-reported studies are needed.

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## Appendix

The supplemental material of this chapter can be consulted online at the Open Science Framework (OSF) repository: <https://osf.io/tzma2/> (DOI 10.17605/OSF.IO/TZMA2)

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## Abstract

Evidence Gap Maps can be defined as thematic collections of evidence structured around a framework that graphically and schematically represents the types of interventions and outcomes relevant to a particular issue. They are useful inputs for defining the agenda and funding of future research and supporting the creation of evidence-based policies. The objective of this Evidence Gap Map is providing a visual overview of health outcomes affected by strategies for delaying sexual activity onset to prevent pregnancy in the adolescence. The findings showed that most intervention components had indifferent effect on delaying or intention to delay sexual intercourse and on reduction of pregnancy between the compared groups, or presented limited data. In addition, most studies included in this Evidence Gap Map presented high risk of bias. In this sense, more well-designed studies assessing pregnancy prevention as a primary outcome are needed to fill the gap in the evidence on effectiveness of interventions and their components to delay sexual activity to prevent pregnancy in adolescence.

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**Keywords:** pregnancy in adolescence; prevention; evidence gap map.

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## Introduction

Evidence Gap Maps (EGMs) may be defined as a visual and interactive product obtained through a systematic evidence synthesis. EGMs share the same methodological principles as systematic reviews, i.e., are developed from a structured research question, from which a broad search is carried out in the scientific literature, the retrieved studies are selected according to previously established eligibility criteria, and the data from the included studies are systematically extracted. Nevertheless, EGMs usually address broader research questions when compared with systematic reviews, and the assessment of the methodological quality and risk of bias of included studies is not mandatory for EGMs, although recommended [1].

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When considering whether to produce gap maps or to perform a systematic review, the research aims should be initially defined. While systematic reviews summarize the information available in the literature, EGMs compile what evidence is available. Hence, systematic reviews are conducted with the aim of informing decision makers about the efficacy, effectiveness, safety of available technologies, and EGMs are used to inform research opportunities and priorities, generating interactive maps as a final product. Additionally, to perform EGMs it is important to consult stakeholders, which should participate in scoping definition, framework development, piloting, identification of the sources for research and promotion of the use of the produced map [2].

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Regarding presentation of results, while systematic reviews may include a statistical synthesis (i.e., meta-analysis), for the reporting of EGMs a few software are available to generate the interactive maps, as Stata, R and EPPI-reviewer, which also presents a machine learning functionality and may be used for search, screening, and coding. Finally, considering that as new studies are published, the evidence gathered by synthesis studies tends to become outdated. Hence, it is recommended that systematic reviews are updated every three years, while EGMs should be annually updated [2,3].

A summary of differences between systematic reviews and EGMs is shown in **Table 1** and an example of a gap map is exhibited in **Figure 1**.

| Table 1. Differences between systematic reviews and EGMs |                                                                                                                                                                      |                                                                                                               |
|----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------|
| Domain                                                   | Systematic review                                                                                                                                                    | Evidence and gap map                                                                                          |
| <b>Research question</b>                                 | Structured based on PICOS (Population, Intervention, Comparison, Outcomes, Study design). Usually focuses on a specific intervention and assesses specific outcomes. | Also structured based on PICOS; however, the scope of interventions and assessed outcomes is usually broader. |
| <b>Search strategy</b>                                   | Comprehensive and systematic search usually restricted to primary studies.                                                                                           | Comprehensive and systematic search that may also include secondary studies (e.g., systematic reviews).       |
| <b>Study selection</b>                                   | Studies are selected by two independent reviewers by applying inclusion and exclusion criteria.                                                                      | Studies are selected by two independent reviewers by applying inclusion and exclusion criteria.               |

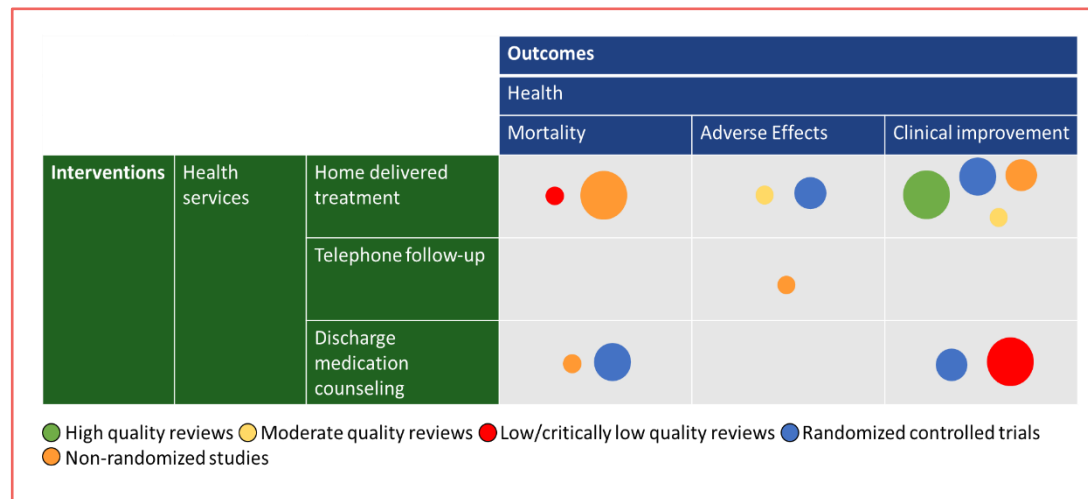
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**Table 1. Differences between systematic reviews and EGMs**

| Domain                      | Systematic review                                                                                                                                                                                                   | Evidence and gap map                                                                                                                          |
|-----------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Critical appraisal</b>   | Critical appraisal is mandatory for systematic reviews. Methodological quality of included studies is evaluated by applying specific tools (e.g., Cochrane Risk of Bias Tool for randomized controlled trials [4]). | Critical appraisal is not mandatory for EGMs but is recommended. When performed, should follow the same principles as for systematic reviews. |
| <b>Data extraction</b>      | Exhaustive data extraction, including study characteristics, participants characteristics, detailed results (e.g., efficacy, safety outcomes).                                                                      | Less data is extracted, including characteristics of the study and interventions (e.g., types of intervention, types of outcomes).            |
| <b>Evidence synthesis</b>   | Evidence may be combined through statistical (i.e., meta-analysis) or narrative synthesis.                                                                                                                          | Evidence is not synthesized in EGMs.                                                                                                          |
| <b>Reporting</b>            | Evidence is systematically reported.                                                                                                                                                                                | Available evidence is reported in the form of an interactive map, in a graphical way.                                                         |
| <b>Purpose for practice</b> | To provide information to guide clinical practice and policy.                                                                                                                                                       | To inform research opportunities and priorities.                                                                                              |

Source: adapted from Saran et al., 2018 and Aromataris et al., 2020.

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**Figure 1.** Example of a gap map

Among the evidence synthesis studies (e.g., systematic reviews, scoping reviews, rapid reviews), EGMs are the newest of these products. Commonly, the first published EGMs aimed to present the relevant available evidence on a particular subject, however, they were produced without a standardized method for conduct and reporting [5]. In 2018, Saran and White (2018) published a discussion paper aiming to introduce general principles to produce EGMs, in order to standardize a methodological approach to be followed by researchers. Later, in 2020, a guidance to produce EGMs was published by the Campbell Collaboration [2], one of the organizations involved in the production and dissemination of EGMs. Another organization involved in EGMs diffusion is the International Initiative for Impact Evaluation (3ie), which also published a paper addressing concepts within the scope of EGMs [6]. Therefore, it is possible to notice how fast EGMs are increasing in popularity, especially considering that the first study to apply this method was published in 2003, and in 2017 more than

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73 EGMs have been published [7]. Since EGMs provide an accessible and user-friendly graphic product of the available evidence, it is expected that this tool will be increasingly explored by researchers and decision makers.

Considering the findings of the systematic review showed in Chapter 3, the current chapter provides an Evidence Gap Map of health outcomes affected by strategies for delaying sexual activity onset to prevent pregnancy in the adolescence, which may guide future research on the subject.

## Development of an evidence gap map

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The findings of the previous systematic review were synthesized in an EGM considering the outcomes (delay of sexual intercourse, intention to delay sexual intercourse, and reduction of pregnancy), results obtained for each outcome (in favor of intervention, in favor of control, and indifferent for compared groups), and risk of bias of the primary studies stratified by intervention component. The risk of bias of primary studies was grouped into three categories: low (low for RoB 2.0, ROBINS-I, and NOS), moderate (some concerns for RoB 2.0; and moderate for ROBINS-I and NOS) or high (high for RoB 2.0 and NOS; and serious or critical for ROBINS-I).

**Table 2** shows an EGM summarizing the effect of intervention components on delaying sexual intercourse, intention to delay sexual intercourse, and reduction of pregnancy alongside with their risk of bias. Most

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intervention components had indifferent effect on these outcomes for compared groups, except for teachers in combination with other professionals on delaying sexual intercourse in comprehensive interventions (high risk of bias); and adolescents and other recipients of the intervention, in person communication, school-only settings, and other providers of intervention (nurses) on the intent to delay intercourse in abstinence-only interventions (high risk of bias). However, the number of comprehensive interventions evaluating teachers and other professionals as providers of intervention and the number of abstinence-only interventions is small, which makes it difficult to interpret the effectiveness of these components. Previously, Chin et al. (2012) [8] also did not find consistent evidence of different effects on outcomes for any of the 12 critical moderator variables evaluated on preventing adolescent pregnancy.

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EGMs do not allow answering a specific research question because they do not seek to synthesize the findings of the included studies. Instead, EGMs are a very broad overview of the evidence allowing researchers, clinicians, and policymakers to visualize and explore the available evidence [7, 9]. It was possible to identify the lack of evidence in several scenarios (gray box), especially related to the outcome “reduction of pregnancy”, highlighting several opportunities for future research (Table 2). In this sense, our findings indicate that more well-designed studies (e.g., randomized controlled trials, with a larger number of participants, and longer follow-up time) and with pregnancy reduction as a primary outcome are needed to fill the gap in the evidence on effectiveness of interventions and their components to delay sexual activity to prevent pregnancy in adolescence.

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## Conclusions

This EGM provided a visual overview of health outcomes affected by strategies for delaying sexual activity onset to prevent pregnancy in the adolescence. Overall, the findings indicated that the effectiveness of interventions and their components were indifferent for compared groups in primary studies, which presented high risk of bias. Only a few intervention components (provider of intervention in comprehensive interventions; recipient of the intervention, method of communication, provider of intervention, and setting in abstinence-only interventions) demonstrated positive results, but with limited evidence available.

Table 2. Evidence Gap Map for outcome group, risk of bias, and effect by intervention components

| Component of intervention  |                                                  | Delay of sexual intercourse |       |        |       | Intention to delay of sexual intercourse |        |        |       | Reduction of pregnancy |       |       |  |
|----------------------------|--------------------------------------------------|-----------------------------|-------|--------|-------|------------------------------------------|--------|--------|-------|------------------------|-------|-------|--|
| Comprehensive intervention | Contact with the recipient                       |                             |       |        |       |                                          |        |        |       |                        |       |       |  |
|                            | Group                                            | ↑ (9)                       | ↑ (1) | ↔ (21) | ↔ (1) | ↑ (5)                                    | ↔ (6)  | ↔ (3)  | ↔ (1) | ↓ (1)                  |       |       |  |
|                            | Individual                                       | ↑ (1)                       | ↑ (1) | ↔ (2)  |       | ↔ (3)                                    |        |        |       |                        |       |       |  |
|                            | Group and individual                             | ↑ (5)                       | ↔ (5) | ↓ (1)  |       | ↑ (1)                                    | ↔ (3)  |        | ↔ (1) |                        |       |       |  |
|                            | Recipient of the intervention                    |                             |       |        |       |                                          |        |        |       |                        |       |       |  |
|                            | Only adolescents                                 | ↑ (12)                      | ↑ (2) | ↔ (27) | ↔ (1) | ↓ (1)                                    | ↑ (6)  | ↔ (12) | ↑ (1) | ↔ (5)                  | ↔ (1) | ↓ (1) |  |
|                            | Adolescents and others <sup>a</sup>              |                             | ↑ (2) | ↔ (3)  |       |                                          | ↔ (1)  |        |       |                        |       |       |  |
|                            | Method of communication                          |                             |       |        |       |                                          |        |        |       |                        |       |       |  |
|                            | In person                                        | ↑ (14)                      | ↑ (1) | ↔ (27) | ↔ (1) | ↑ (6)                                    | ↔ (10) | ↑ (1)  | ↔ (5) | ↓ (1)                  |       |       |  |
|                            | In person and remote                             | ↑ (1)                       | ↔ (2) | ↓ (1)  |       | ↔ (2)                                    |        |        | ↔ (1) |                        |       |       |  |
|                            | Only remote                                      |                             | ↑ (1) | ↔ (2)  |       | ↔ (2)                                    |        |        |       |                        |       |       |  |
|                            | Setting                                          |                             |       |        |       |                                          |        |        |       |                        |       |       |  |
|                            | Only school                                      | ↑ (12)                      | ↑ (1) | ↔ (22) |       | ↑ (6)                                    | ↔ (10) | ↑ (1)  | ↔ (3) | ↔ (1)                  | ↓ (1) |       |  |
|                            | School and others <sup>b</sup>                   | ↑ (1)                       | ↔ (4) | ↓ (1)  |       | ↔ (2)                                    |        |        | ↔ (2) |                        |       |       |  |
|                            | Community                                        | ↑ (2)                       | ↑ (1) | ↔ (2)  | ↔ (1) |                                          |        |        |       |                        |       |       |  |
|                            | Provider of intervention                         |                             |       |        |       |                                          |        |        |       |                        |       |       |  |
|                            | Trained facilitators/<br>educators/mentors/staff |                             | ↑ (6) | ↔ (19) |       | ↑ (3)                                    | ↔ (4)  | ↑ (1)  | ↔ (3) | ↔ (1)                  |       |       |  |
|                            | Teachers                                         | ↑ (2)                       | ↑ (1) | ↔ (3)  |       | ↑ (1)                                    | ↔ (2)  |        | ↔ (2) | ↓ (1)                  |       |       |  |
|                            | Teachers and others <sup>c</sup>                 |                             | ↑ (3) | ↓ (1)  |       | ↑ (1)                                    | ↔ (3)  |        |       |                        |       |       |  |
|                            | Health educators, others <sup>d</sup>            |                             | ↑ (1) |        |       |                                          |        |        |       |                        |       |       |  |
|                            | Others <sup>e</sup>                              |                             | ↑ (2) | ↔ (6)  |       | ↑ (1)                                    | ↔ (1)  |        |       |                        |       |       |  |

Table 2. Evidence Gap Map for outcome group, risk of bias, and effect by intervention components

| Component of intervention    |                                              | Delay of sexual intercourse |       | Intention to delay of sexual intercourse |       | Reduction of pregnancy |       |
|------------------------------|----------------------------------------------|-----------------------------|-------|------------------------------------------|-------|------------------------|-------|
| Abstinence-only intervention | <i>Contact with the recipient</i>            |                             |       |                                          |       |                        |       |
|                              | Group                                        | ↑ (1)                       | ↔ (2) | ↑ (2)                                    | ↔ (2) | ↑ (1)                  | ↔ (1) |
|                              | Individual                                   |                             |       |                                          |       |                        |       |
|                              | Group and individual                         |                             |       | ↑ (1)                                    |       |                        |       |
|                              | <i>Recipient of the intervention</i>         |                             |       |                                          |       |                        |       |
|                              | Only adolescents                             | ↑ (1)                       | ↔ (2) | ↑ (1)                                    | ↔ (2) | ↑ (1)                  | ↔ (1) |
|                              | Adolescents and others <sup>f</sup>          |                             |       | ↑ (2)                                    |       |                        |       |
|                              | <i>Method of communication</i>               |                             |       |                                          |       |                        |       |
|                              | In person                                    | ↑ (1)                       | ↔ (1) | ↑ (2)                                    | ↔ (1) | ↑ (1)                  | ↔ (1) |
|                              | In person and remote                         |                             |       | ↑ (1)                                    |       |                        |       |
|                              | Only remote                                  |                             |       |                                          |       |                        |       |
|                              | <i>Setting</i>                               |                             |       |                                          |       |                        |       |
|                              | Only school                                  | ↑ (1)                       | ↔ (2) | ↑ (2)                                    | ↔ (1) | ↔ (1)                  |       |
|                              | School and others <sup>g</sup>               |                             |       | ↑ (1)                                    | ↔ (1) | ↑ (1)                  |       |
|                              | Community                                    |                             |       |                                          |       |                        |       |
|                              | <i>Provider of intervention</i>              |                             |       |                                          |       |                        |       |
|                              | Trained facilitators/educators/mentors/staff | ↑ (1)                       |       |                                          |       | ↑ (1)                  |       |
|                              | Teachers                                     | ↑ (1)                       |       |                                          |       | ↑ (1)                  |       |
|                              | Teachers and others <sup>h</sup>             | ↔ (1)                       |       | ↔ (1)                                    |       |                        |       |
|                              | Health educators, others <sup>i</sup>        |                             |       | ↑ (1)                                    | ↔ (1) |                        |       |
|                              | Others <sup>j</sup>                          |                             |       | ↑ (2)                                    |       |                        |       |

Keys for directions: ↑ = in favor of intervention; ↓ = in favor of control; ↔ = indifferent for compared groups.

Keys for colors: red = high risk of bias; yellow = moderate risk of bias; green = low risk of bias; grey = no evidence available.

The number within the cells denote the number of interventions appraised.

<sup>a</sup> = Other recipients included parents, caregivers, teachers, and other family members.

<sup>b</sup> = Other settings included recipient's home, community centers, a summer youth employment and sports program, juvenile detention centers and neighborhood settings, tribal community health centers, tribal boys and girls' clubs, after school and summer youth programs.

<sup>c</sup> = Other providers of interventions included trained facilitator, staff, educator, community leader, healthcare professional, counselor, college student and wellness coordinator.

<sup>d</sup> = Other providers of interventions included community leaders and teachers.

<sup>e</sup> = Other providers of interventions included students, sexual health educators, trained community members, native paraprofessionals, youth peer-group leader, actor-educator.

<sup>f</sup> = Other recipients included parents, caregivers, healthcare professionals and general public.

<sup>g</sup> = Other settings included community centers, club, conferences, summer camps, recreation centers, homeless family shelters.

<sup>h</sup> = Other providers of interventions included trained staff, educator.

<sup>i</sup> = Other providers of interventions included youth ambassadors, community colleagues and professionally trained social workers.

<sup>j</sup> = Other providers of interventions included nurses.

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## Abstract

Educational strategies to promote health and prevent disease face the same challenges as any other Evidence-Based Practice (EBP): becoming implementable in the real world and promoting the benefits achieved in clinical trials. In this context, Implementation Science (IS) emerges to promote the absorption of innovations into routine practice, impacting the effectiveness of interventions and health care. Discussing the main aspects related to health education in IS is essential to complement the approaches in this book and empower decision-makers and researchers on the main tools in the area. Different methodological approaches, such as experimental, observational, and qualitative designs, are used in IS to address problems ranging from evaluating the effectiveness of implementation strategies to understanding the phenomenon and stakeholders' perceptions. The use of optimization and effectiveness-implementation hybrid trials and mixed methods in the evaluation of implementation outcomes is increasing, reducing the time between the production of evidence and the "implementability" of innovations. Regardless of the design and methods used, research must be guided by implementation frameworks, models, and theories. There are more than 60 theories, models, and frameworks in IS identified in the literature, although no approach has been demonstrated to be superior or more consistently useful. In addition, the definition of the implementation outcome to be evaluated is important, since it differs from the clinical research outcomes and indicates the effectiveness of implementation strategies. Finally, some implementation research initiatives applied to health education interventions were summarized and presented as examples of implementation methods, strategies, and outcomes.

**Keywords:** evidence-based practices; implementation science; translational science; health education.

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## Introduction

Evidence-Based Practice (EBP) has provided substantial progress in determining the efficacy and effectiveness of health innovations but has failed to guarantee the routine use of safe, effective, and reliable practices in the real world [1,2]. There are a variety of personal, organizational, and contextual factors that influence the use of innovations [1]. Consequently, users often do not benefit from more innovative interventions, generating a gap between research and practice [2].

Albers, Shlonsky, and Mildon (2020) propose an ideal decision-making model *“the intersection of what we currently know (current best evidence), what consumers prefer and are likely to accept (consumer preferences and actions), and their individual circumstances as they relate to the issue at hand (clinical state and circumstances)”* [3]. In this context, it is important to understand the aspects that influence the implementation of educational strategies to prevent teenage pregnancy, for example. As seen previously, although the social and public health emergency of teenage pregnancy is clear [4], studies on educational strategies are poorly reported, compromising the synthesis of the effectiveness of interventions. It is still necessary to consider the cultural and social aspects of each educational environment [5,6]. Attitudes, values, and beliefs are factors associated with the external context that may or may not encourage the delivery of innovation by governments, for example [7].

In this sense, Implementation Science (IS) is the field that emerged to address the gap between research and practice, accelerating the implementation

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of innovations [2]. Implementation Science is defined as “the scientific study of methods to promote the systematic uptake of research findings and other evidence-based practices into routine practice, and, hence, to improve the quality and effectiveness of health services and care” [8]. In other words, IS is the scientific inquiry into questions concerning implementation [9]. This science is primarily interdisciplinary and applied to key areas such as health, social welfare, and education [3], with a focus on a systems-level approach to improving care as well as concepts when making decisions on modifications to care delivery, including the context of the setting, the organization itself, the stakeholders (providers, staff, patients, and administrators), the process being examined, and health outcome enhancements for individuals [10].

Regarding educational interventions and programs, the pressure to adopt and implement an EBP to improve outcomes for students and schools can undermine the impact of an initiative. Stakeholders and practitioners can use the IS to increase the likelihood of success when moving a new EBP, such as increasing students’ academic, behavioral, and social-emotional outcomes [11]. Moreover, IS often starts with implementation strategies, including the enhancement of the capabilities of government (public policy, oversight, and financing agencies), the improvement of the performance of implementing and provider organizations, the strengthening of the capabilities and performance of individual providers and front-line workers, the empowering of the communities and households, and the support of the multiple stakeholders engaged in improving health [9,11].

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This chapter aims to discuss the main factors related to the IS in health education, including concept and definition; implementation strategies, implementation research methods; theories, models, frameworks of implementation; implementation outcomes; and implementation research applied to educational interventions.

## Defining Implementation Science

IS is the scientific study of strategies and methods used to integrate EBP into different settings to maximize their effectiveness, bridging the gap between theory and effective practice. This scientific approach provides a better comprehension of how effective strategies can be transferred to different contexts with success [12]. IS focuses on identifying and addressing multi-level factors that help or impede EBP adoption and sustainment [13].

The applicability and relevance of implementation research can vary across different domains and research topics. Some research questions may require a greater focus on implementation aspects while others may not. IS often needs implementation strategies to deliver or implement new interventions as well as use theories, models, and-or frameworks to understand implementation processes, and measure implementation outcomes [9].

Innovations or interventions can be spread in organizations in different ways. Diffusion refers to the passive, unplanned, and untargeted spread of information or interventions. Dissemination refers to the targeted distribution of

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information and intervention materials to a specific audience, focusing on improving a practice or policy audience's knowledge and awareness, but is not enough to change professional behavior. Implementation means using deliberate strategies in specific settings to adopt new interventions, integrate them effectively, and change practice patterns [14].

Moreover, it is important to distinguish IS from Improvement Science, which refers to systems-level work to improve the quality, safety, and value of health care and takes a pragmatic approach (measuring performance) to the reduction of poor performance in health [10].

## Implementation strategies

Implementation strategies are systematic intervention processes to incorporate evidence-based interventions or practices into regular services and are designed to improve implementation outcomes. These strategies can be classified into three categories: discrete, multifaceted, and blended. Discrete strategies are the most recognizable and commonly cited implementation actions and involve one process or action (e.g., reminders, educational meetings). Multifaceted strategies use two or more discrete strategies (e.g., training plus technical assistance). Blended strategies are used when some discrete strategies, addressing multiple levels and barriers to change, are packaged as an implementation intervention [15].

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More than 70 types of discrete implementation strategies were described by Powell et al. [16], strengthening conceptual clarity, relevance, and comprehensiveness of implementation strategies that could be used either individually or in combination for implementation practice and research [16]. The large majority of them are relevant to the implementation and sustainment of EBPs in the education field. Some common implementation strategies used in the education sector [13]:

- ⊙ Professional development and active training: enhancing the skills and knowledge of members of the educational community;
- ⊙ Coaching and mentoring: supporting members of the educational community in implementing evidence-based interventions or practices by providing ongoing guidance and feedback;
- ⊙ Collaborative learning communities: bringing together members of the educational community to exchange knowledge, experience, and problem-solve challenges related to the implementation of evidence-based interventions;
- ⊙ Data-driven decision-making and systems incentives: incorporating data into decisions related to the selection, implementation, and monitoring of evidence-based interventions and practices;
- ⊙ Leadership training: enabling leaders at all levels to adopt and integrate evidence-based interventions or practices, while providing the necessary support and resources.

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## Implementation research methods

Implementation research seeks to understand what, why, and how innovations work and test strategies to improve them. Thus, the research can consider any aspect of the implementation, from the process itself, the factors that affect it, and the results obtained [2,17]. Unlike clinical research, implementation research is not focused on evaluating the effects of innovation, but on understanding the phenomena involved and evaluating strategies that increase the incorporation and sustainability of the intervention [1,9].

However, implementation research does not have a set of research designs of its own, sharing many of the elements and assumptions of efficacy research and involving a wide variety of qualitative, quantitative, and mixed methods applied according to the purpose [9,18]. Research methods and tools are established from the definition of a research question related to an implementation problem [17]. Defining the implementation problem and, consequently, the research question is paramount in IS, as implementation research questions can cover different topics that may require different methodologies and epistemological and ontological assumptions [17,19].

In general, experimental studies aim to evaluate the effectiveness of the implementation strategies of an already proven effective innovation [20]. Due to their scope, participants in implementation trials are typically organizations and stakeholders and, as with clinical trials, proper randomization and comparison groups minimize the occurrence of bias [20]. The CONSORT (Consolidated Standards of Reporting Trials) 2010 statement can assist researchers in reporting

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the implementation of randomized trials [21]. However, unlike clinical trials that seek greater internal validity, implementation trials are, in general, pragmatic, developed in "real-world" contexts [9,20] and the PRECIS-2 (PRagmatic Explanatory Continuum Indicator Summary) tool can help researchers define whether to carry out a pragmatic implementation trial [22]. In health education, for example, a pragmatic implementation trial could aim to "evaluate the effectiveness of an implementation strategy (toolkit, technical assistance, funding, and so on) concerning usual practice (generally, not carrying out any intervention) to improve acceptability (implementation outcome) of comprehensive sex education programs (clinical intervention) by secondary school teachers (trial target population) to adolescents to prevent unplanned pregnancy (clinical outcome)". A compilation of implementation strategies was carried out by the Expert Recommendations for Implementing Change (ERIC) project and can be used alone or combined by researchers and policymakers involved with the implementation of health education strategies [16].

Many implementation strategies are complex and composed of multi-components, which can increase the need for resources and make it difficult to identify which component is contributing to the implementation result [23,24]. In this context, it is possible to evaluate the performance of individual components of the implementation strategy submitted to a rigorous randomized trial, denominated optimization trial [23,24]. In the optimization trial, the contribution of each component can be evaluated, as well as different combinations and their interactions, ordering, and/or their dose, being able to identify an ideal combination [23,24]. The Multiphase Optimization Strategy (MOST) is "a

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framework for development, optimization, and evaluation of behavioral, biobehavioral, and biomedical interventions” and involves three sequential phases: preparation, optimization, and evaluation, and can be used in the context of IS [25]. When the research question involves identifying the sequence optimization in which the implementation strategies should be used, a Sequential Multiple Assignment Randomized Trial (SMART) assay can be developed [23,24]. The SMART is a generalization of randomized controlled trials, in which participants are randomized more than once, based on the intermediate outcomes achieved, and allows refining interventions or adaptive strategies, and can also be used in IS [23,24].

However, considering the context of implementation trials, it is not always possible or interesting to develop a randomized study [20]. The evaluation of strategies involving a regulatory change on educational curriculum at the national level, for example, is unlikely to allow random assignment in a clinical trial. In this context, the development of a range of quasi-experimental designs arises. As they are not randomized, quasi-experimental studies seek to establish a comparison with units (control group or time period) with initial characteristics similar to the intervention group (or time period) [23,26]. The pre-post with a non-equivalent control group, interrupted time series, and stepped wedge designs are examples of quasi-experimental implementation research [23,26].

From the perspective of integrating efficacy, effectiveness, and implementation research, increasing the speed of clinical outcomes for routine adoption, hybrid effectiveness-implementation designs emerged [27]. In general terms, hybrid studies assess the outcomes of innovation and implementation

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strategies based on a single design [27]. The three types of hybrid study designs vary their goals on a continuum between innovation effectiveness and implementation outcomes. A type 1 hybrid design has as its primary objective to determine the effectiveness of an innovation (clinical intervention) and, secondarily, to identify what is necessary for its implementation (barriers, facilitators, and strategies, for example) [27]. The hybrid design type 2 aims both to evaluate the effectiveness of innovation and the potential impact of implementation strategies [27]. The evaluation of the implementation outcomes obtained from implementation strategies while evaluating the clinical outcomes obtained in this context is the purpose of a type 3 hybrid trial [27].

Unlike other approaches, in observational designs, there is no intervention by the researcher. In general, they are used to describe the occurrence of an outcome or the relationship between the occurrence of an outcome and exposure, being more subject to confounding factors and risk of bias [28]. In IS, observational designs can be usefully used to assess implementation contexts and processes, and describe the outcomes of implementation strategies [18]. Researchers can use the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement and its extensions for reporting observational implementation studies [29]. On the other hand, Knox et al. (2022) proposed an observational-implementation hybrid approach, in which, in addition to the traditionally epidemiological objectives, observational studies would be used to collect relevant implementation data, allowing anticipation or inferences about the implementation of innovations and the strategies to support it [30].

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Unlike other approaches, qualitative designs seek to study human behavior and experience, which makes them particularly useful in IS [31]. In many implementation processes, there is interest in understanding how this phenomenon occurs, what factors influence it, and even how strategies to support implementation can be designed, making qualitative designs essential to respond to such implementation problems in a rigorous and efficient way [31,32]. Qualitative research involves several research methodologies (ethnography, action research, grounded theory, phenomenology) and a set of methods, such as participant observation, in-depth interviews, and focus groups [33]. In IS, the qualitative methodologies employed tend to be more positivist and deductive and the methods more practical and directed [31]. Different guidelines can assist researchers in reporting the findings of implementation research [34-36].

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Finally, quantitative and qualitative approaches can be integrated and applied in IS, based on mixed methods designs [32]. Mixed methods designs have been employed to measure intervention or implementation outcomes and understanding the process; to explore a phenomenon and testing modeled hypotheses; to analyze the context of implementation and the outcomes of implementation or innovation; understanding the perspectives of stakeholders of the innovation; compensating for weaknesses in the use of other methods [37].

A summary of the general applications of the study designs and examples of implementation research in health education can be seen in **Table 1**. Regardless of the design and methods used to respond to an implementation problem, research must be guided by implementation frameworks, models, and theories [27,31,32].

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**Table 1. Main applications of study designs in Implementation Science and examples in the field of health education**

| Study design                                                                                                            | Application                                                                                                                                                                                                                                                                                                 | Examples                                 |
|-------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------|
| <b>Experimental</b><br>(pragmatic clinical trial, optimization trials, sequential multiple assignment randomized trial) | Employed to evaluate the effectiveness of implementation strategies (implementation outcomes) for effective innovations, in "world-real" contexts [20]. Implementation strategies can be optimized, as well as their application sequence in a randomized controlled trial [23].                            | Wang et al. [38]<br>Schutte et al. [39]  |
| <b>Quasi-experimental</b><br>(pre-post, interrupted time series, stepped wedge designs)                                 | Used to assess the effectiveness of implementation strategies (implementation outcomes), where randomization of participants or locations is not possible [26].                                                                                                                                             | Hernandez et al. [40]                    |
| <b>Effectiveness-implementation hybrid</b> (types 1, 2, and 3)                                                          | Designed when seeking to evaluate the outcomes of innovation and implementation strategies [27]. The three types of hybrid study designs vary their objectives on a continuum of balance between evaluating innovation effectiveness and implementation outcomes.                                           | Chen et al. [41]                         |
| <b>Observational</b><br>(cohort studies, case-control studies, cross-sectional studies, case series, case reports)      | Employed to describe the occurrence of an implementation outcome or the relationship between the occurrence of an outcome and exposure, as well as to describe implementation of processes and contexts [18].                                                                                               | Mueller et al. [42]<br>Locke et al. [43] |
| <b>Qualitative</b>                                                                                                      | Performed when there is an interest in understanding how the implementation phenomenon occurs, which factors influence it, which implementation support strategies can be designed, and to support the understanding of the perceptions and values of the users of the innovation and stakeholders [31,32]. | Eisman et al. [44]<br>Walker et al. [45] |
| <b>Mixed</b>                                                                                                            | Used when the integration of quantitative and qualitative methods can facilitate the analysis of implementation and its outcomes [32,37], compensating for the use of other methods alone.                                                                                                                  | Ott et al. [46]<br>Eisman et al. [47]    |

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## Frameworks, theories, and models of implementation

Theories, models, and frameworks are essential tools in IS because they help researchers and practitioners to identify, organize, and understand the complex processes involved in implementing interventions [48]. Theories are broad explanations and-or analytical principles related to observation, understanding, and explanation of the world, providing a set of concepts, definitions, and assumptions that assist researchers to develop hypotheses, designing studies, and interpreting data [19,48]. Models are simplified representations of reality that help to explain complex phenomena based on specific theories and are used to guide the development and implementation of interventions [19,48]. Frameworks are broader than models and provide a set of principles or guidelines for how to approach a problem and are often used to guide the development of interventions or to organize and synthesize evidence from multiple studies [19,48].

These approaches can be classified into four categories, depending on the purpose of their use [19,48]:

- ⊙ Process: describe and-or guide the process (steps) of implementation;
- ⊙ Determinant: understand and-or explain what may influence implementation outcomes;
- ⊙ Evaluation: identify outcomes that can be used to assess implementation efforts;
- ⊙ Hybrid: merge objectives of previous approaches.

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There are more than 60 theories, models, and frameworks in IS identified in the literature, although no approach has been demonstrated to be superior or more consistently useful [49]. Their selection should therefore consider some points, such as the purpose of the framework, the level(s) included within the framework, the degree of inclusion and depth of analysis or operationalization of implementation concepts, and the framework's orientation, which includes the setting and type of intervention for which the framework was originally designed [50]. The **Table 2** below describes the most used tools in IS.

**Table 2. Main theories, models, and frameworks used in Implementation Science**

| Name                                                                                | Purpose                                                                                                                                                 | Structure                                                                                                                             | Website                                                           |
|-------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------|
| <b>Consolidated Framework for Implementation Research (CFIR) [7]</b>                | A determinant framework that provides a systematic approach for studying the implementation of evidence-based interventions in real-world settings.     | List of 48 theoretical constructs across five domains (innovation, outer setting, inner setting, individuals, implementation process) | <a href="https://cfirgui.de.org/">https://cfirgui.de.org/</a>     |
| <b>Active Implementation Frameworks (AIF)</b>                                       | A determinant framework that provides comprehensive and structured processes to support the effective implementation of evidence-based practices (EBPs) | Five frameworks (usable innovations, implementations stages, implementation drivers, implementation teams, improvement cycles)        | <a href="https://nirn.fpg.unc.edu/">https://nirn.fpg.unc.edu/</a> |
| <b>Promoting Action on Research Implementation in Health Services (PARIHS) [51]</b> | A hybrid (determinant and process) framework that provides an approach for understanding the complex and multi-faceted nature of implementation.        | Core constructs are facilitation, innovation, recipients (individual and collective), and context (inner and outer)                   | --                                                                |

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**Table 2. Main theories, models, and frameworks used in Implementation Science**

| Name                                                                            | Purpose                                                                                                                                                           | Structure                                                                                                                                     | Website                                                             |
|---------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------|
| <b>Exploration, Preparation, Implementation, and Sustainment (EPIS) [52,53]</b> | A hybrid (determinant and process) framework that provides a structured approach for planning, implementing interventions, and evaluating their impact over time. | Four well-defined phases that describe bridging factors and innovation factors related to the outer system and inner organizational contexts. | <a href="https://episframework.com/">https://episframework.com/</a> |
| <b>RE-AIM model [54]</b>                                                        | An evaluation model that guides the planning and evaluation of programs                                                                                           | Five main domains (Reach, Effectiveness, Adoption, Implementation Maintenance)                                                                | <a href="https://re-aim.org/">https://re-aim.org/</a>               |

## Implementation outcomes

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Implementation outcomes refer to the effective actions to implement evidence-based interventions, policies, or practices in real-world settings. In addition, these outcomes provide invaluable insight into the factors that facilitate or hinder successful implementation, i.e., serve as indicators of how well a given implementation is working [9,55].

It is important to highlight that the implementation outcomes differ from the services/client outcomes (e. g., client-centeredness, effectiveness, efficiency, equity, safety, timeliness, satisfaction, function, and symptomatology) that refer to the degree to which achieves its intended effect in a problem-specific and user-focused [55,56]. Proctor et al. [55] defined eight implementation outcomes, which are described in **Table 3**.

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**Table 3. The definition and commonly used terms of the implementation outcomes**

| Implementation outcome     | Definition                                                                                                                                                                     | Commonly used terms                                                                                                   |
|----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------|
| <b>Acceptability</b>       | The extent to which an intervention or practice is perceived as agreeable or satisfactory by stakeholders, including those who will implement it and those who will receive it | Satisfaction with various aspects of the innovation (e.g., content, complexity, comfort, delivery, and credibility)   |
| <b>Adoption</b>            | The extent to which an intervention or practice is taken up and used by organizations or individuals.                                                                          | Uptake; utilization; initial implementation; intention to try                                                         |
| <b>Appropriateness</b>     | The perceived fit or relevance of the intervention in a particular setting or for a particular target audience (e.g., provider or consumer)                                    | Perceived fit; relevance; compatibility; suitability; usefulness; practicability.                                     |
| <b>Feasibility</b>         | The extent to which an intervention can be carried out in a particular setting or organization                                                                                 | Actual fit or utility; suitability for everyday use; practicability                                                   |
| <b>Fidelity</b>            | The extent to which an intervention or practice is implemented as intended, including adherence to the original core components, plan, or policy                               | Delivered as intended; adherence; integrity; quality of program delivery.                                             |
| <b>Implementation Cost</b> | The resources required to successfully implement an intervention, including financial costs, time costs, and opportunity costs.                                                | Marginal cost; cost-effectiveness; cost-benefit.                                                                      |
| <b>Penetration</b>         | The extent to which an intervention is integrated into a service setting                                                                                                       | Level of institutionalization; Spread; Service access                                                                 |
| <b>Sustainability</b>      | The extent to which an intervention or practice continues to be delivered over time, even after initial implementation efforts have ended.                                     | Maintenance; continuation; durability; incorporation; integration; institutionalization; sustained use; routinization |

Source: adapted from Proctor et al. [55].

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Implementation outcomes can be assessed using a variety of methods, including surveys, interviews, observation, and administrative data [55]. According to the Implementation Outcome Repository, there are instruments with evidence of validity to measure the majority of these outcomes in several fields, except for the fidelity and implementation costs [57].

Not all these outcomes are of equal importance in the delivery of implementation research. Measures of acceptability, adoption, appropriateness, and feasibility might be related to implementing a novel intervention. For existing interventions, measures of fidelity are often very important, as well as implementation costs and penetration. Research on health interventions often neglects sustainability issues, even though they should be considered from the onset of intervention [9].

## Implementation research applied to educational interventions

Several studies in IS have been conducted in a variety of settings, including healthcare, education, social services, and public sectors. In the education field, a scoping review identified 36 publications in this theme of interest. Only eight studies were implementation effectiveness studies (all performed in the United States of America - U.S.) and reported implementation outcomes that were achieved through the test of different implementation strategies and 28 studies were implementation quality studies, which reported on the effectiveness of interventions and included an indicator of implementation quality. The primary two implementation outcomes measured in these studies

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were fidelity (the degree to which an intervention was implemented as intended) and acceptability (the degree to which users and stakeholders of an intervention accept its relevance and importance). Finally, the implementation strategies utilized in these studies always included training of the personnel delivering the intervention and ongoing staff support. Although the review confirms that IS is a domain of interest to education science, the application of concepts and models is underdeveloped and emerging slowly [58].

A recent systematic review was performed to evaluate the benefits and harms of strategies aiming to improve school implementation of interventions to address student diet, physical activity, tobacco or alcohol use, and obesity. Thirty-eight studies were included, of these, 22 were conducted in the U.S. and 26 used RCT designs [59]. All trials used multiple implementation strategies, such as educational materials, educational outreach, and educational meetings [59]. There was a large effect, supporting improved implementation among schools receiving implementation support compared with usual care or minimal support control. Thus, the authors highlight that the review provides evidence supporting the use of implementation strategies to improve the implementation of interventions targeting risk factors for chronic disease in schools, mainly student diet, and physical activity [59].

Chin et al. [60] assessed the effectiveness of group-based comprehensive risk-reduction and abstinence education interventions for reducing adolescent pregnancy, HIV, and other Sexually Transmitted Infections (STI) through a systematic review. Seven key outcomes were identified by authors (current sexual activity; frequency of sexual activity; the number of sex partners;

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frequency of unprotected sexual activity; use of protection, including condoms and/or hormonal contraception; pregnancy; and STIs. Overall, data from the meta-analysis showed that group-based comprehensive risk reduction was found to be an effective strategy to reduce all outcomes, except abstinence education [60]

A feasibility and optimization study among 81 teachers in 24 schools in the Bahamas was conducted to evaluate the effects of two implementation strategies (biweekly monitoring/feedback and site-based assistance/mentorship) on teachers' delivery of an evidenced-based HIV prevention program. The strategies are effective in promoting teachers' implementation of youth evidence-based interventions [38].

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Schutte et al. [39] performed a RCT in the Netherlands to evaluate the effect of the Web-based coaching intervention on teacher implementation of a school-based sex education program. A total of 43 schools with 83 teachers participated in the study. The findings showed that e-coaching was not effective in enhancing the completeness and adherence to the program by teachers [39].

In the U.S., a mixed-method study was carried out to examine qualitative and quantitative data on implementation determinants for an evidence-based health curriculum that addresses appropriate cognitive, attitudinal, and contextual factors related to health behaviors [47]. The authors identified three domains (acceptability, intervention-context fit, and adaptability), in which teachers reported low acceptability also and fidelity of the interventions [47].

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A study conducted with adolescents of the two middle schools in rural settings described the use of the CFIR to implement community resiliency-focused teen pregnancy prevention programs [46]. Data included program staff interviews, feedback from local partners, community meeting notes, and participant surveys [46]. The authors showed that the use of a community resilience approach facilitated the successful implementation in these schools, and key components analyzed by CFIR were the explicit attention to community priorities; use of local champions; partnering with local agencies; and use of a train-the-trainer approach in these rural communities [46].

Hernandez et al. [40] performed a pilot test with an innovative theory- and web-based decision support system (called iCHAMPSS) for the diffusion of sexual health evidence-based programs. Pre- and post-tests (quasi-experimental study) were administered to measure usability parameters (acceptability, ease of use, helpfulness, perceived impact, credibility, and motivational appeal) and short-term psychosocial outcomes (knowledge of programs; attitudes toward programs; perceived barriers; self-efficacy to adopt, implement, and maintain a program; and perceived support of programs by district stakeholders) [40]. The tool iCHAMPSS showed the capacity to accelerate the uptake of the diffusion of sexual health [40].

Finally, a study conducted a secondary data analysis through multilevel modeling grounded in the difference-in-differences (DID) framework to explore how levels of program implementation impacted the program's effect on targeted student health outcomes, using two surveys that assessed student behaviors and experiences and school policies and practices [61]. The schools were supported

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in implementing three strategies: delivering exemplary sexual health education, increasing student access to quality sexual health services, and enhancing safe and supportive school environments (SSE) [61]. The authors found an association between increased implementation of activities to enhance safe and supportive school environments and positive effects on multiple student outcomes, highlighting that education agencies should emphasize improving school environments [61].

## Conclusions

Implementation science is a universal strategy to ensure that programs make sustainable positive differences and needs to be incorporated into the design and evaluation of every school program to ensure effectiveness and sustainability.

In the field of educational health, different implementation strategies can be tested by applying different methods and frameworks to assess their effectiveness outcomes. The choice must consider aspects of the implementation context, the type of innovation of interest, and the implementation problem to be researched.

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High rates of adolescent pregnancy and associated sexual risk behaviors remain a major public health concern globally, with important health, social, and economic burdens. Different comprehensive and abstinence-only educational interventions have been developed and implemented in several settings in the past years to prevent or minimize the harms associated with this event. Nonetheless, the available evidence on their effectiveness and risk-benefit ratio is still inconsistent and scarce. Further well-designed and well-reported studies to help stakeholders enabling decision-making process within public policies for this population are needed. Moreover, the implementation of educational strategies in the real world should target the translation and extension of the benefits achieved in clinical trials. This book provides a broad review on the epidemiological and social impacts of adolescent pregnancy, summarizes the results of secondary studies that assessed the effectiveness or otherwise of educational interventions intended to reduce this outcome, identifies some gaps on the literature over this theme by means of an evidence gap map, and finally discusses the implementation science in health education.

