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Clinical and Biological Outcomes in School and Community-Based Sexual Health Interventions for Youth: An Umbrella Review

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Abstract

Background: Sexual health is essential to overall well-being, especially during adolescence and young adulthood when sexual identity develops. Lack of support may result in STIs, unintended pregnancies, and psychological harm. Although non-technology-based interventions are widely used, their impact on clinical outcomes remains uncertain.

Methods: This umbrella review, conducted in accordance with PRISMA guidelines, evaluated the impact of these interventions on biological and clinical outcomes among individuals aged 10–30 years. A systematic search of PubMed, Scopus, and Web of Science was performed up to October 2023. Eligible systematic reviews reported outcomes including STI incidence, pregnancy rates, and viral load, and were assessed using the Joanna Briggs Institute (JBI) checklist. Nineteen systematic reviews met the inclusion criteria.

Results: Overall, interventions improved knowledge, attitudes, and some self-reported behaviors such as condom use, but showed limited effects on biological outcomes. School-based and peer-led interventions did not significantly reduce HIV or HSV-2 incidence or pregnancy rates. Interpersonal interventions showed mixed effects on viral load, while hybrid approaches increased HIV testing uptake without evidence of reduced infection rates.

Conclusion: These findings highlight a gap between behavioral improvements and clinical outcomes. Future research should use stronger designs, longer follow-up, and multi-level approaches addressing structural barriers.

Background

Sexual health is a multifaceted concept that extends beyond the mere absence of disease and is recognized as a fundamental pillar of human health and well-being throughout the lifespan. The World Health Organization (WHO) defines sexual health as a state of physical, emotional, mental, and social well-being in relation to sexuality; it is not merely the absence of disease, dysfunction, or infirmity (2). This definition implies a positive and respectful approach to sexuality and sexual relationships, as well as the possibility of having pleasurable and safe sexual experiences, free from coercion, discrimination, and violence (3). To fully grasp this concept, one must consider its diverse dimensions: physical health (encompassing the proper functioning of reproductive systems and the capacity for sexual pleasure), emotional and mental health (involving comfort with one's sexuality and the maintenance of healthy relationships), and social and cultural health (reflecting individual interactions regarding sexual matters, sexual rights, and the influence of cultural norms) (4, 5).

Adolescence and young adulthood represent critical developmental windows characterized by the formation of sexual identity and the initiation of behaviors related to sexual and reproductive health (6). During this period, the absence of adequate sexual health support can precipitate severe negative consequences. Physically, this age group faces heightened risks, including a disproportionate burden of

sexually transmitted infections (STIs) and unintended pregnancies, the latter often associated with serious obstetric and social complications (7). Psychologically, insufficient knowledge and negative sexual experiences can contribute to anxiety, depression, and diminished self-esteem (7). Socially, the repercussions may manifest as unhealthy relationships and social isolation stemming from stigma or negative attitudes (7). Consequently, promoting sexual health among adolescents and young adults is not only a public health imperative but also a vital investment in the future, achievable through access to accurate information, the development of essential skills, and the creation of supportive environments (8).

In response to these challenges, a wide array of educational and preventive interventions has been implemented to enhance the sexual health of youth. While digital tools and mobile health (mHealth) applications have gained traction due to their accessibility and broad reach, non-technology-based methods—such as interactive workshops, school-based education, and face-to-face counseling—remain a cornerstone of public health strategies (9–11). These traditional approaches offer distinct advantages, particularly in facilitating sensitive discussions through direct interaction, building trust between facilitators and participants, and providing contextually relevant information tailored to specific community needs (12, 13). Despite the large volume of research dedicated to these non-technological approaches, systematic reviews evaluating their effectiveness have yielded inconsistent results, particularly regarding the durability of behavior change and the translation of knowledge into health protection (14–16).

A significant limitation in the existing literature is the predominant focus on cognitive and behavioral proxies—such as knowledge, attitudes, and self-reported condom use—rather than on "hard" clinical endpoints. While improvements in knowledge and intent are valuable, they do not automatically guarantee a reduction in disease burden. To date, there has been a paucity of comprehensive synthesis specifically examining the impact of non-technology-based interventions on definitive biological and clinical outcomes, such as confirmed STI incidence, pregnancy rates, and viral load suppression. Understanding the efficacy of these interventions in altering biological endpoints is crucial for validating their role in public health policy.

Given the importance of non-technology-based interventions and the urgent need to clarify their true impact on health status, the present study was designed as an umbrella review. Unlike previous reviews that may have prioritized behavioral metrics, this study specifically aims to synthesize evidence regarding the effectiveness of non-technology-based interventions on clinical and biological outcomes in adolescents and young adults. By focusing on hard endpoints, this review seeks to determine whether traditional educational and counseling modalities can effectively bridge the gap between behavioral intent and biological reality. The findings from this synthesis will provide policymakers, program planners, and sexual health professionals with the critical evidence required to make informed decisions when designing and implementing evidence-based interventions, ultimately aiming to reduce the incidence of STIs and unintended pregnancies among the youth population.

Method

1. Study design

This umbrella review was conducted in accordance with the PRISMA (Preferred Reporting Items for Systematic Review and Meta-Analysis) guidelines (17) and received ethical approval from the ethics committee of Tehran University of Medical Sciences (IR.TUMS.FNM.REC.1403.112). The study protocol was designed to systematically synthesize evidence regarding the impact of interventions on clinical endpoints.

2. Search strategy

A comprehensive and systematic search was performed across three major electronic databases—Web of Science, Scopus, and PubMed—to identify relevant systematic reviews. The search covered the period from the inception of each database up to October 1, 2023, with no language restrictions applied. A Boolean search strategy was employed combining keywords related to interventions ("Early Intervention," "Intervention," "Education," "Prevention Program," "Program") and sexual health ("Sexual Health"), alongside demographic terms targeting the specific population ("Adolescent*," "Teenager*," "Youth," "Teen," "Young Adult*"). This strategy ensured a broad yet sensitive retrieval of literature relevant to the review's objectives.

3. Inclusion and exclusion criteria

To be eligible for inclusion, systematic reviews were required to evaluate the effectiveness of non-technology-based interventions aimed at improving sexual and reproductive health (SRH) in settings such as schools, communities, hospitals, or clinics. Crucially, included reviews must have reported data on biological or clinical outcomes (e.g., incidence of STIs, pregnancy rates, or viral load) within adolescent and young adult populations (aged 10–30 years). Reviews were excluded if they did not focus on this demographic, lacked relevance to SRH, failed to meet systematic review standards, or predominantly assessed technology-based interventions. Additionally, studies focusing exclusively on specific subgroups, such as sexual minorities or LGBTQ individuals, were excluded to ensure the findings were generalizable to the broader adolescent and young adult population, given the distinct behavioral and social dynamics associated with these specific subgroups.

To determine eligibility regarding "Clinical and Biological Outcomes," the outcomes section of each study was rigorously screened against predefined criteria. Studies were included in this review if they reported at least one of the following "hard" endpoints: laboratory or diagnostic outcomes (e.g., biological confirmation of HIV/STIs or physiological indicators such as viral load); pregnancy and birth outcomes (including rates of pregnancy, abortion, or live birth, irrespective of the measurement method); documented physical outcomes (e.g., recorded physical injuries or mortality); and specific preventive medical actions (e.g., receipt of vaccinations or pharmacological treatments). Conversely, studies were excluded if their reported outcomes exclusively consisted of self-reported behaviors (e.g., condom use

or number of sexual partners without biological verification), cognitive and psychosocial outcomes (e.g., knowledge, attitudes, intentions, or self-efficacy), or perception-based outcomes (e.g., self-suspected conditions without clinical confirmation).

4. Outcomes

The primary focus of this umbrella review was on clinical and biological endpoints, including the incidence or prevalence of sexually transmitted infections (STIs, including HIV), pregnancy rates (unintended pregnancy and birth rates), and viral markers (viral load and suppression). While cognitive and behavioral outcomes (such as knowledge, attitudes, and condom use) were recorded, they were considered secondary to the primary objective of assessing changes in biological health status.

5. Data extraction

All identified records were imported into EndNote, and duplicates were removed. Two researchers independently screened the titles and abstracts of the remaining articles. Studies meeting the preliminary criteria underwent a full-text review by the same researchers to determine eligibility and extract data. Disagreements were resolved through discussion or consultation with a third researcher. Data extraction utilized a pre-defined form to capture details such as study objectives, participant characteristics (age, sample size), intervention type, setting, and specific biological outcomes reported. For quantitative data, effect sizes, confidence intervals, and measures of heterogeneity (I^2) related to clinical endpoints were extracted.

6. Assessment of risk of bias

The methodological quality of the included systematic reviews was independently assessed by two researchers using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Systematic Reviews and Research Syntheses (18). This tool consists of 11 items rated as “Yes,” “No,” “Unclear,” or “Not Applicable.” Based on the overall assessment, studies were categorized as “Include,” “Exclude,” or “Seek further information.” This rigorous process ensured that only high-quality evidence was synthesized in the final analysis.

7. Data synthesis

Given the heterogeneity in the types of biological outcomes reported, a narrative synthesis approach was primarily employed to analyze the data. The findings were categorized based on intervention modality (e.g., school-based, peer-led, interpersonal) and the specific biological outcome assessed (e.g., STI incidence, pregnancy, viral load). This narrative approach allowed for a comprehensive evaluation of the effectiveness of different interventions in achieving clinical endpoints. Where sufficient quantitative data regarding biological outcomes were available across reviews, the potential for meta-analysis was considered; however, the primary synthesis relied on a structured narrative comparison to address the review's focus on clinical efficacy.

Results

Study selection

An initial search using the primary search strategy across selected databases resulted in the identification of 259 systematic reviews. After removing 31 duplicate articles, 228 articles were screened based on pre-defined eligibility criteria during the title and abstract review phase. It is important to note that the primary search strategy was designed to be broad and included studies reporting various sexual health outcomes. Therefore, to specifically address the objectives of this review focusing on clinical and biological endpoints, a rigorous screening process was conducted. During the screening phase, studies that did not report biological or clinical outcomes (such as pregnancy, STI incidence, or viral load) were excluded, even if they focused on behavioral or cognitive metrics. The search results and the stages of article inclusion and selection are shown in Figure 1, in accordance with the PRISMA checklist. Of these, 133 articles progressed to the full-text review stage, and 84 were excluded for reasons detailed in Figure 1 (primarily the absence of biological endpoints). Ultimately, 19 studies that met the strict criteria for including biological and clinical outcomes were selected for this umbrella review. Search Strategy in Databases are presented in **Table 1.**

Characteristics of included reviews

The present umbrella review synthesizes the findings from 19 studies focusing on sexual health interventions. These studies were selected because they specifically provided data on clinical endpoints, distinguishing them from the larger body of literature focused solely on knowledge or attitude changes. The age range of adolescents and young participants in the studies was between 10 and 30 years. The included studies were categorized based on the type of intervention and setting. Of the 19 studies reviewed, 8 studies (42.1%) focused on peer-led interventions; 5 studies (26.3%) covered school-based educational interventions delivered by teachers or health professionals; and 2 studies (10.5%) focused on individual and psychological interventions (such as counseling and motivational interviewing). Furthermore, some studies involved multi-component interventions that also engaged families and communities. Characteristics of included reviews are presented in **Table 2.**

Risk of bias assessment

The methodological quality of the included systematic reviews was independently assessed by two researchers using the Joanna Briggs Institute (JBI) Critical Appraisal Checklist for Systematic Reviews and Research Syntheses (18). The evaluation confirmed that all included studies met the required quality standards. Consequently, based on the overall assessment, all studies were categorized as “Include” and were retained for the final analysis, ensuring that only high-quality evidence was synthesized in this review.

Analysis of biological and clinical outcomes

The analysis of biological and clinical outcomes, as detailed in **Table 3**, reveals significant variations in the effectiveness of different intervention types. The distribution of these biological endpoints across the included studies is further illustrated in Table 4. The studies have been categorized by intervention modality to facilitate comparison.

Quality of evidence and interpretation of inconclusiveness

The observation that interventions failed to significantly alter biological endpoints may not solely reflect a failure of the intervention strategies themselves, but could also be attributed to limitations in the primary studies. Many of the included reviews reported heterogeneity in study designs, small sample sizes, and variations in follow-up durations, which can reduce the statistical power to detect changes in clinical endpoints like STI incidence or pregnancy rates. Furthermore, the reliance on self-reported biological measures in some primary studies introduces the risk of bias. Therefore, while the current evidence suggests limited efficacy in altering biological outcomes, this conclusion is tempered by the variable quality of the primary data. Future studies with more rigorous designs and longer follow-up periods are required to definitively assess the biological impact of these interventions.

School-based and educational interventions

School-based sexual health education interventions demonstrated limited efficacy in altering biological endpoints. For instance, studies such as Tolli et al. (2012) and Cardoza et al. (2012) found that while these interventions often led to short-term improvements in behavioral outcomes like condom use, they showed no significant impact on the incidence or prevalence of HIV and Herpes Simplex Virus 2 (HSV-2) infections. Similarly, broader interventions involving education, skills training, and mass media, such as those reviewed by Sani et al. (2016) and Salam et al. (2016), failed to produce significant reductions in pregnancy rates at the biological level, despite improvements in participants' knowledge.

Peer-led interventions

The evidence regarding peer-led interventions was largely inconclusive regarding biological outcomes. Reviews focusing specifically on peer-led adolescent sexual health education, such as Tolli (2012) and Sun et al. (2018), showed no clear evidence of effectiveness in preventing biological outcomes such as HIV infection or adolescent pregnancy. While these interventions were successful in improving knowledge and attitudes, they did not convincingly reduce risky sexual behaviors or biological incidence rates. In the comparison of peer-led and teacher-led interventions, such as the review by Shepherd et al. (2010), the majority of models did not clearly reduce risky behaviors, with only a minority of studies reporting significant behavioral improvements. Furthermore, broader reviews of peer education in EU settings concluded that despite the popularity of this approach, there is limited evidence of its effectiveness in preventing biological outcomes.

Interpersonal and psychological interventions

Interpersonal interventions, including counseling, motivational interviewing, and cognitive-behavioral techniques (CBT), showed mixed results for HIV-positive youth. Studies such as Laurenzi et al. (2021) and Muheriwa Matemba et al. (2021) indicated that while these interventions had a positive effect on viral load levels, they did not consistently achieve significant viral suppression or an undetectable viral load status. This suggests that while psychosocial support can improve adherence, the translation to complete biological suppression remains inconsistent.

Family and community-based interventions

Family, community, and school-based interventions that utilized in-person sessions, media, or computer activities also failed to demonstrate a significant association with the reduction of pregnancy or STI contraction. As seen in the reviews by Evans et al. (2020) and Kedzior et al. (2020), although these interventions significantly improved abstinence, condom use, and psychological outcomes such as self-efficacy, these behavioral changes did not translate into statistically significant improvements in biological endpoints like pregnancy or STI rates.

Asset-based interventions

Interventions addressing individual and community level health assets, such as those reviewed by Ware et al. (2019), showed an indirect impact on biological risks. Advanced negotiation follow-up significantly reduced risky sexual behaviors, suggesting a potential pathway to improving biological outcomes. However, direct biological markers (like STI incidence) were not the primary focus of reported significance in these studies.

Technology-based and hybrid interventions

Face-to-face and technology-based interventions, as well as those led by trained staff or psychologists, such as the study by Mon Kyaw Soe N et al. (2018), were the only category to report a positive impact on a biological endpoint, specifically leading to increased uptake of HIV/STI testing. However, it should be noted that while increased testing is a positive behavioral step, it is an intermediate outcome and does not necessarily reflect a reduction in disease incidence. Consequently, the table notes that even here, interventions generally had a stronger effect on knowledge and motivation than on biological endpoints.

Overall, the evidence suggests that while current sexual health interventions are effective in enhancing cognitive and behavioral outcomes, their efficacy in altering clinical endpoints (biological outcomes) remains limited across most intervention types.

Discussions

This umbrella review was conducted to evaluate the effectiveness of sexual health interventions on clinical and biological outcomes. Through a rigorous examination of 259 initial systematic reviews, 19 studies meeting strict criteria—including outcomes such as pregnancy, sexually transmitted infections (STIs), and viral load—were ultimately selected. The results of the analysis of these studies indicate that

although diverse interventions, including school-based education, peer-led interventions, and individual counseling, have been implemented across age groups 10 to 30 years, their effectiveness in altering biological outcomes remains very limited. Specifically, school-based and peer-led interventions, despite improving knowledge and short-term behaviors, failed to demonstrate significant reductions in pregnancy rates or the incidence of HIV/HSV-2. Only hybrid interventions (face-to-face and technology-based) showed a positive effect on increasing HIV testing; however, this outcome is an intermediate indicator and does not necessarily lead to a reduction in disease incidence. These findings suggest that success in cognitive and behavioral domains does not necessarily translate into improvements in clinical and biological indicators.

One of the key findings of this research is the ineffectiveness of school-based educational interventions in changing biological outcomes such as pregnancy and sexually transmitted infections. Studies by Tolli et al. (2012) and Cardoza et al. (2012) showed that despite improvements in condom use, the prevalence of HIV and HSV-2 did not decrease. This finding aligns with the results of other systematic reviews that have focused on traditional education. For instance, a systematic review by Fonner et al. (2014) demonstrated that school-based education can increase knowledge, but its impact on HIV prevalence remains uncertain (19). The primary reason for this discrepancy and lack of success in biological outcomes can be explained using the "Theory of Planned Behavior." According to this theory, attitude and behavioral intention (which are targeted in education) are merely predictors of behavior, while behavior itself is influenced by environmental factors and behavioral control (20). In real-world settings, structural barriers such as insufficient access to condoms or social pressures prevent the translation of intention into safe behavior and, consequently, a reduction in biological outcomes. Therefore, education alone, without environmental change, is insufficient.

Another finding of this study is the inconclusive and unsubstantial evidence regarding the effectiveness of peer-led interventions in preventing biological outcomes. Studies by Sun et al. (2018) and Shepherd et al. (2010) indicated that although these interventions are popular and improve attitudes, there is insufficient evidence for reducing pregnancy or HIV. This is consistent with the review by Medley et al. (2009), which found the effectiveness of peer education to be variable (21). The reason for this ineffectiveness can be sought in "Social Network Theory." In this theory, the influence of peers depends on the network structure and the credibility of the peers. In many interventions, selected peers may lack sufficient credibility within their peer groups, or the educational messages may not align with the group's actual norms. Furthermore, peer interventions are often short-term, whereas changing sexual norms and reducing biological risk requires deep and long-term penetration into social networks (22).

This umbrella review also showed that interpersonal and psychological interventions (such as counseling and motivational interviewing) have mixed results regarding biological outcomes. Laurenzi et al. (2021) reported that while these interventions could improve viral load levels, they did not necessarily lead to complete viral suppression. This finding aligns with the review by Hutton et al. (2019) regarding the effectiveness of motivational interviewing on treatment adherence (23). The difference in results (improved viral load without complete suppression) can be explained by the "Health Belief Model" and

the concept of perceived barriers (24). Although counseling can increase risk perception and perceived benefits of treatment, psychological barriers such as disease denial, fear of stigma, and psychosocial problems hinder 100% adherence to treatment. Thus, while psychosocial support is sufficient for improving adherence, achieving the ultimate biological outcome (viral suppression) requires overcoming more complex and structural barriers.

Finally, the findings indicated that family and community-based interventions also failed to show a significant association with the reduction of biological outcomes. Evans et al. (2020) found that despite improvements in self-efficacy and abstinence, pregnancy and STI rates did not decrease. This is consistent with the review by DiClemente et al. (2009), which emphasized the challenges of family-based interventions in adolescents (25). The reason for this mismatch between behavior and biological outcome can be explained by "Ecological Systems Theory." Adolescents interact with multiple systems (family, school, peers). Interventions that focus solely on the family may not be able to neutralize the dominant influences of other systems, such as media or peer groups, which promote risky sexual behaviors (26). Therefore, behavioral change at the family level does not necessarily lead to a change in biological outcomes unless all environmental layers are aligned.

The strengths of this umbrella review include a systematic and comprehensive search approach, the precise selection of studies based on strict criteria focused on clinical and biological outcomes, and a critical analysis of the quality of evidence, which creates a clear distinction between improvements in behavioral indicators and actual health outcomes. However, this study also faces certain limitations, including significant heterogeneity in the designs of primary studies, small sample sizes, and variations in follow-up durations, which limit the power of definitive inference. Furthermore, the exclusive focus on non-technological interventions and the lack of direct comparison with fully digital approaches, as well as the potential for publication bias in the included primary studies, are other limitations that must be considered when interpreting the results.

Conclusion

This umbrella review provides a comprehensive synthesis of evidence regarding the impact of sexual health interventions on clinical endpoints among adolescents and young adults. The findings reveal a significant disparity between the success of interventions in modifying cognitive and behavioral outcomes—such as knowledge, attitudes, and self-reported condom use—and their limited efficacy in altering biological outcomes, including STI incidence, pregnancy rates, and viral suppression. While school-based, peer-led, and interpersonal interventions demonstrate value in enhancing psychosocial determinants of health, they frequently fail to translate these improvements into measurable biological benefits, often due to structural barriers, insufficient follow-up durations, and the complexity of behavioral translation in real-world settings. Notably, hybrid interventions incorporating technology show promise in increasing service uptake, yet their impact on disease reduction remains inconclusive. Consequently, future research must prioritize rigorous methodological designs with longer follow-up periods and adequate statistical power to detect changes in biological endpoints. Moreover, there is a

critical need to shift from isolated educational strategies to multi-level, ecological approaches that address structural and environmental barriers, thereby bridging the gap between behavioral intent and actual biological health outcomes.

Declarations

Conflict of Interest

The authors haven't any conflict of interest.

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Tables

Tables 1 to 4 are available in the supplementary files section

Figures

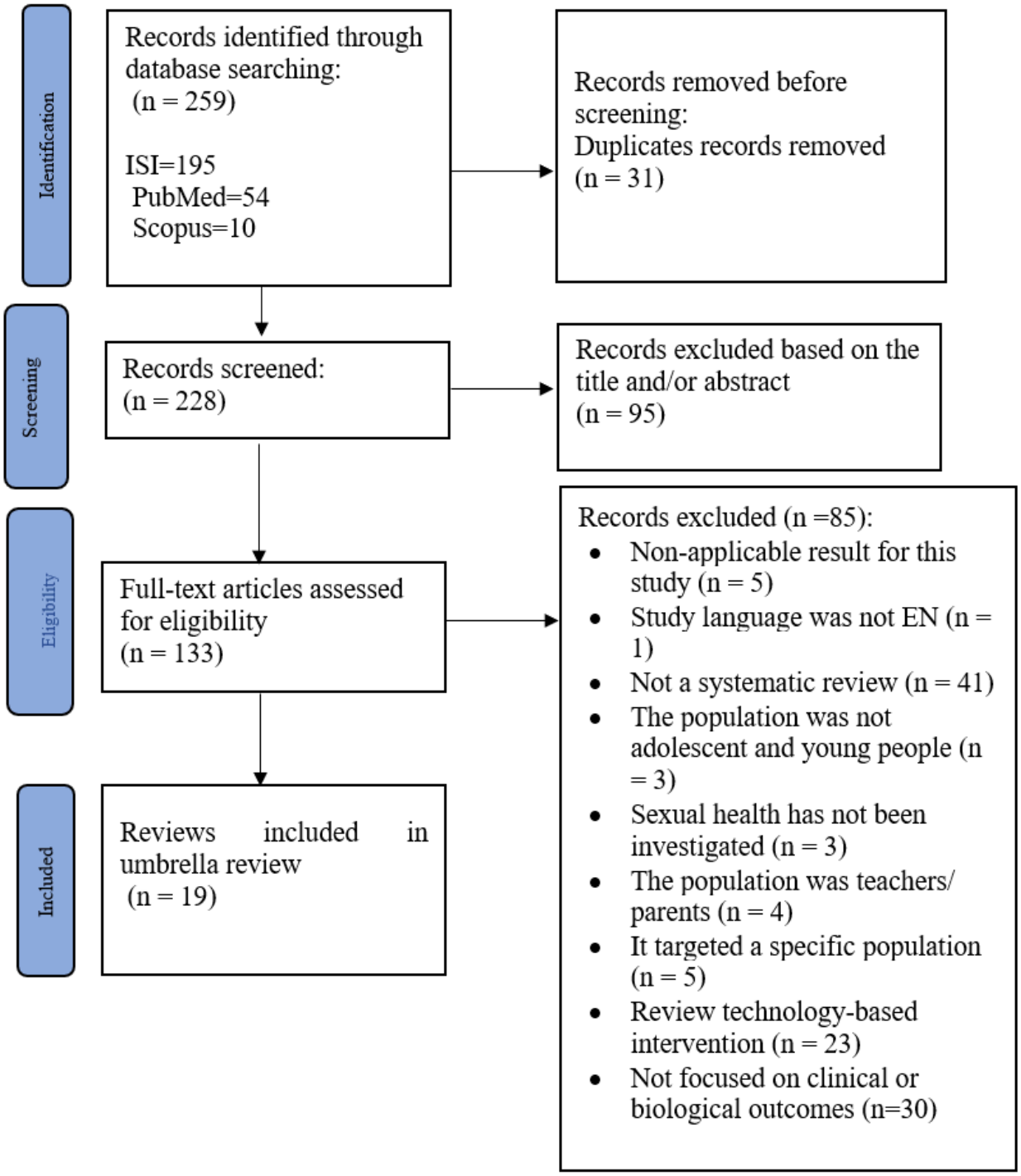


Figure 1

PRISMA flow diagram for studies selection

Supplementary Files

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- Tables.docx