School-Based Sexual Health Education Interventions in Sub-Saharan Africa: A Multiple Case Study

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Abstract:
School-based sexual health education is one of the most comprehensive and effective ways of promoting young people's sexual health, reducing risky sexual behaviours and preventing sexually transmitted infections. This study investigated the design, implementation and evaluation of seven school-based sexual health education interventions in five sub-Saharan African countries, to identify features that may be associated with effectiveness or ineffectiveness on self-reported condom use and preventing sexually transmitted infections. A multiple case study design was employed. Data from each intervention were collected through documents review and interviews with key investigators. Data were analysed using a combination of case study methods. The findings confirmed that interventions that had greater numbers of features recommended by previous evidence synthesis studies were more likely to be effective. Findings suggested that young people's sexual health needs assessment could be improved by applying ethnography, and Sexual Script research, which, in turn, could make interventions more effective. School-based interventions should consider environmental factors by incorporating community-based approaches and using ecological models as theories underpinning interventions. Interventions were also more likely to be effective if delivered by both teachers and peer educators. Finally, optimum impact is likely if young people are exposed to interventions for at least two years/academic sessions. Future intervention design should consider these features to optimise effectiveness of school-based sexual health education in sub-Saharan Africa.
Keywords: School-based sexual health education, sub-Saharan Africa, condom use, STI/HIV prevention, multiple case study

INTRODUCTION

School-based sexual health education interventions are programmes that have been promoted in school settings to improve sexual health and relationships among young people, by reducing risky sexual behaviours and preventing sexually transmitted infections (STIs), including Human Immunodeficiency Virus (HIV). School-based HIV-preventive interventions, starting in primary schools, are recommended as a necessary foundation for non-school-based preventive interventions (Gallant & Maticka-Tyndale, 2004) for three reasons. First, schools can provide knowledge and skills to the majority of young people. Second, studies have shown that most young people initiate sexual activity while they are of school age. Finally, evidence has shown that interventions are most effective in preventing STIs if initiated in primary schools, prior to sexual debut (Gallant & Maticka-Tyndale, 2004). Widespread implementation of school-based sexual health education has also been recommended due to high quality evidence of their effectiveness on some STI-related outcomes (see Mavedzenge, Luecke, & Ross, 2014 for a global review).

Despite these recommendations, the effectiveness of school-based sexual health interventions in sub-Saharan Africa in preventing STIs, including HIV, is limited. In fact, to date, no such intervention has demonstrated a significant HIV-preventive effect in sub-Saharan Africa (Denford, Abraham, Campbell, & Busse, 2016; Mason-Jones et al., 2016; Sani, Abraham, Denford, & Ball, 2016). This is disappointing considering the devastating effects of the HIV pandemic in the sub-continent. Sub-Saharan Africa where just 12% of global population live, bears more than 70% of the world HIV burden with young people, especially young women aged 15-24, being disproportionately affected (Kharsany & Karim, 2016). Therefore, effective HIV prevention in sub-Saharan Africa has potential to reduce the global HIV-related health

burden. Young people are the 'window of opportunity' for HIV prevention and school-based HIV prevention interventions offer a means to halt spread of the infection in the general population (Gallant & Maticka-Tyndale, 2004).

Several studies have recommended design, implementation and evaluation characteristics of school-based sexual health education that could be associated with effectiveness. Kirby, Laris, and Rolleri (2006) provided a widely cited review identifying intervention characteristics associated with effective STI prevention and this was recently updated by Denford et al. (2016) in a review of reviews of school-based sexual health interventions, worldwide. Reviews of studies from sub-Saharan Africa have also provided helpful recommendations (Gallant & Maticka-Tyndale, 2004; Kaaya, Mukoma, Flisher, & Klepp, 2002; Paul-Ebhohimhen, Poobalan, & Teijlingen, 2008; Sani et al., 2016).

The present study aimed to identify characteristics explaining why school-based sexual health education interventions are, or are not, effective in promoting condom use and/or preventing STIs/HIV in sub-Saharan Africa. We explored features of intervention design, implementation, and evaluation that may be associated with effectiveness. Our focus was on carefully-selected cases that is different from previous evidence synthesis studies, by examining particular interventions in detail, including unpublished project documents and interviews with researchers involved in seven large-scale interventions implemented and evaluated in five sub-Saharan African countries.

METHODS

Design:

A qualitative multiple case study was undertaken. Case studies are relevant to understanding 'how' and 'why' social interventions work, and facilitate in-depth exploration of interventions and their real-life contexts (Yin, 2014). Cases for this study were defined as school-based sexual health education interventions implemented and evaluated in sub-Saharan Africa, and were selected from a recent systematic review of school-based sexual health interventions in sub-Saharan Africa (Sani et al., 2016). Seven out of the 31 interventions included in the review were purposively selected using the following criteria, each intervention was:

  i. Implemented in large number of schools (more than 50 schools) and/or was evaluated using a large number participants (more than 1000);
 ii. Implemented in countries with high burden of HIV infection;
iii. Shown to be either effective or ineffective in promoting self-reported condom use and/or preventing STIs/HIV;
 iv. Supported by documents in addition to published journal articles; and
  v. Involved researchers were willing and available to be interviewed.

Overview of the included cases[1]:

The seven interventions varied in size and were implemented in five sub-Saharan African countries (Kenya, Nigeria, South Africa, Tanzania and Zimbabwe). Four of the seven interventions were implemented in Nigeria and South Africa; the two countries with the highest burden of HIV in the region. Some of the interventions included a combination of community- and school-based programmes (see Table 1, for the summary of the cases).

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[1] We intended to include the Peer Education Evaluation Project: a provincial initiative that was implemented in 150 high schools and evaluated among 3934 students in the Western Cape, South Africa (Mason-Jones, Flisher, & Mathews, 2013). However, we had difficulty in recruiting researchers involved in this project. We were only able to interview a researcher involved in the evaluation of the project and found it difficult to clarify design and implementation processes.

The Primary School Action for Better Health intervention (PSABH) was implemented in 80 primary schools and communities in Kenya. The intervention trial was evaluated among 3940 students (Maticka-Tyndale, Wildish, & Gichuru, 2007) and was rolled out across the country.

The *MEMA kwa Vijana* intervention (MkV) trial was a multicomponent intervention implemented in 62 primary schools, 18 health facilities and communities in rural Tanzania. The MkV trial was evaluated among 9645 students (Ross et al., 2007) and was rolled out to 649 schools and 177 health facilities (Renju et al., 2010; Renju et al., 2011).

The *Regai Dzive Shiri* project (RDSP) was also a school- and community-based intervention implemented in 82 high schools and 30 communities in Zimbabwe, and evaluated among 3960 participants (Cowan et al., 2010). However, only the community component of the RDSP intervention was rolled out.

The HIV Prevention Intervention for Rural Youth (HP4RY) in Nigeria was also a community- and school-based implemented in 30 secondary schools and 10 communities, and evaluated among 5201 students (Arnold et al., 2012).

The School-Based Reproductive Health Education intervention (SBRHE) was the only secondary-school intervention and was implemented in four schools and evaluated among 1029 students in Nigeria (Ajuwon & Brieger, 2007).

The Promoting Sexual and Reproductive Health, School-based HIV/AIDS Intervention in sub-Saharan Africa (SATZ) was implemented in 56 high schools in South Africa and 24 primary schools in Tanzania. It was evaluated among 12139 students (Mathews et al., 2012).

Finally, the Health Wise South Africa (HealthWise) was implemented in waves including excess of 70 high schools in South Africa. The first wave of the intervention was evaluated among 2383 students (Smith et al., 2008).

Four of the cases (PSABH, HP4RY, HealthWise and MkV) were classified as 'effective' and the remaining three (SBRHE, SATZ, and RDSP) as 'ineffective'. This was based on statistically significant effects on reported condom use (henceforth referred to as condom use) and/or incidence or prevalence of STIs/HIV among at least one sub-group of the participants.

The MkV found statistically significant increase in condom use for first-time users during follow-up, for both males and females (aRR [adjusted rate ratio] =1.41, 95% CI [95% confidence interval] = 1.15-1.73 and aRR=1.30, 95% CI=1.03-1.63, respectively). Similarly, condom use in the last 12 months for males (aRR=1.47, CI=1.12-1.93) and with non-regular partners for females (aRR=1.34, CI=1.07-1.69) (Doyle et al., 2010; Ross et al., 2007) were significantly increased. Moreover, pooled results for both males and females found statistical significant effects on condom use at last sex (OR=1.49, 95% CI=1.32-1.70) (Sani et al., 2016). However, the evaluation of MkV found no statistical significant beneficial or harmful effects on HIV and other STIs (Doyle et al., 2010; Ross et al., 2007).

The PSABH found a statistically significant increase in condom use at last sex for males exposed to condom training through school club and/or a question box for pre-programmes virgins and non-virgins pre-programme (aOR [adjusted odds ratios]=1.56, 95% CI=1.01-2.41 and aOR= 1.47, 95% CI=1.09-2.00, respectively). Long-term follow up also found a significant increase in condom use among girls 18-30 months post intervention (aOR=1.40, 95% CI=1.00-2.30) (Maticka-Tyndale et al., 2007; Maticka-Tyndale, Wildish, & Gichuru, 2010). Furthermore, pooled results for both girls and boys found significant effects on condom use at last sex (OR=1.36, 95% CI=1.12-1.65) (Sani et al., 2016).

The HP4RY intervention found statistically significant effects on condom use at last sex for first-year junior secondary school males (Arnold et al., 2012), and aggregates of results for all classes and genders of participants that received both school and community components of the intervention (OR=1.37, CI=1.14-1.64) (Sani et al., 2016).

The HealthWise found significant effects for risk at last sex including increased condom use (β=-0.16, SE=0.08, p<0.05) (Tibbits, Smith, Caldwell, & Flisher, 2011).

By contrast, the RDSP found no statistical significant effects on condom use (OR=1.01, 95% CI= 0.86-1.19) or STIs including HIV (Cowan et al., 2010; Sani et al., 2016). Similarly, the SATZ found no statistically significant effects on condom use (OR=0.85, 95% CI=0.58-1.25) (Mathews et al., 2012; Sani et al., 2016). When compared to the control group, the SBRHE intervention group also showed no statistically significant effects on condom use (OR=1.34, CI=0.46-3.87) (Ajuwon & Brieger, 2007; Sani et al., 2016).

Data Collection:

Two types of data were synthesised; project documents and interviews with researchers involved in the cases. Documents were identified from electronic databases and contacts with authors for unidentified or unpublished project documents. There was variation in types and number of project documents identified across the seven cases with only two (a journal article and a thesis chapter) for SBRHE and more than 30 for MkV. Interviews were conducted between May and November 2016, and at least one interview was conducted for each case depending on the availability of the researchers. See Table 2 for overview of documents identified and number of interviews conducted. List of the documents for all the cases is available as a supplementary document (Supplementary File 1).

Prior to the interviews, documents were analysed, and summary of the analyses were presented to researchers with requests to provide any missing information and to endorse, clarify or correct initial findings. These together with the researchers' opinions on factors associated with effectiveness or ineffectiveness of their interventions were discussed during the interviews. Interviews were semi-structured, conducted face-to-face or via Skype, audio-recorded and transcribed verbatim. An interview topic guide that is available as Supplementary File 2 guided the interviews.

Data Analysis:

Each intervention was regarded as one case with all documents and interviews from that case analysed collectively so that the case, not the associated documents or interviews, was the unit of analysis. Analyses were completed in four iterative stages using a combination of four analytic techniques proposed by Yin (2014) and Hak & Dul (2010b), that is, 'Pattern Matching', 'Explanation Building', 'Replication Logic', and 'Cross Case Synthesis'.

First, Pattern Matching (Yin, 2014) "*compares an empirically based pattern that is based on the findings from your case study-with a predicted one made before you collected your data*" (p. 143). An Analysis Framework was developed to identify key findings, as well as intervention and study characteristics. The framework was based on recommendations of previous reviews that identified features associated with effective design, implementation and evaluation of school-based, sexual health interventions or health-promoting schools. In particular, we drew upon recommendations based on a comprehensive review of adolescents' sexual health interventions (Kirby et al., 2006) and a subsequent review of reviews of school-based, sexual health interventions worldwide (Denford et al., 2016) as well as reviews of school-based, sexual health interventions in Africa (Gallant & Maticka-Tyndale, 2004; Kaaya et al., 2002; Paul-Ebhohimhen et al., 2008; Sani et al., 2016), a realist review of implementation in health promoting schools (Pearson et al., 2015) as well as a review of evaluations in health promoting schools (Mũkoma & Flisher, 2004). Kirby et al. (2006) is one of the most widely cited reviews of such interventions, which was extended and updated by Denford et al. (2016). Gallant and Maticka-Tyndale (2004), Kaaya et al. (2002), Paul-Ebhohimhen et al. (2008), and Sani et al. (2016) report reviews focusing on school-based sexual health education interventions in sub-Saharan Africa while Mũkoma and Flisher (2004) and Pearson et al. (2015) report evidence synthesis studies based on evaluations and implementations of health promotion interventions in schools, more generally. The Analysis Framework consists of 35 recommendations identified across these reviews.

Intervention Mapping is a protocol widely used in planning health promotion interventions including school-based, sexual health programmes. This protocol sets out sequential stages of intervention development and evaluation. Each recommendation included in our analysis framework was ascribed to one of the six steps of the Intervention Mapping protocol (Eldredge, Markham, Kok, Ruiter, & Parcel, 2016). Table 3 presents the final Analysis Framework. The recommendations in the framework were 'predicted patterns' that served as point of comparison with findings from documents and interviews. The documents and interviews, were read to identify implementation or absence of these recommendations following the principles of Pattern Matching (Yin, 2014). Initially, each source (documents and interviews) were imported into Nvivo 10 qualitative software to facilitate coding. The six stages of Intervention Mapping were used to identify each part of the source and then followed by line by line coding to identify implementation of each of the 35 recommendations in the framework.

The frequency of implementation of the recommendations in each case was noted. Complete implementation was indicated by score of 1.0, partial implementation by a score of 0.5 and a score of zero was allocated when the recommendation was absent. As checking of implementation of recommendations proceeded, cases were compared with one another to check for if findings were repeated across the seven cases. This was facilitated by displaying findings of all the cases in spreadsheets that are available as supplementary documents (Supplementary Files 3-8). This comparison of findings across cases has been referred to as "Replication Logic" (Hak & Dul, 2010b). Finally, conclusions were made by synthesising findings across the seven cases by highlighting the salient features that differentiate the 'effective' from 'ineffective' interventions; a technique referred to as "Cross Case Synthesis" (Yin, 2014).

In addition to checking for implementation of each recommendation across all cases, a narrative explanation of 'why' or 'how' cases were effective or ineffective based on findings from the documents and opinions of researchers involved in the case was developed. This technique is known as Explanation Building (Yin, 2014) and allowed us to make sense of the recommendation scoring patterns.

Ethical Considerations:

The first three authors' institution granted ethical approval for this study. Informed consent for interviews and publication of anonymised data was obtained from each participant.

RESULTS

The recommendations implemented by each case are presented in Table 4. Unsurprisingly, the four effective interventions implemented more of the Intervention Mapping recommendations from the Analysis Framework than the ineffective interventions. MkV scored 33.5 scores out of 35. The HealthWise and PSABH both scored 31 and HP4RY scored of 28.5 among the effective cases. The ineffective interventions implemented fewer recommendations but there was no marked discontinuity between the two sets with the RDSP and SATZ interventions scoring 27.5 and 28.5, respectively. By contrast, SBRHE scored only 20 points. The scoring patterns across cases and their meaning is explained below using the Intervention Mapping steps to structure our consideration of differences in the seven intervention teams' design, implementation and evaluation of their intervention.

Intervention Mapping Step 1: Needs Assessment

As recommended in the Intervention Mapping protocol, all cases reported that formative work was undertaken to inform intervention development. This could include reviews of adolescent sexual health data, review of previous adolescent reproductive health interventions and interviews with relevant stakeholders including young people (Recommendation 1). However, two of the effective interventions (PSABH and HP4RY), in addition, identified sexual scripts that precede young people's sexual encounters during the needs assessment, which informed their development. This was emphasised as a factor that could explain success of the PSABH intervention in interviews: "*The sexual scripts threw light onto issues of expectations during dating, the economic context around sex, the complicity of families in early sex and the inability of both genders to create alternative dialogues and outcomes around dating and sex. This enabled the*

programme to engage at a very honest level with the risk environment faced by young people. Following the sexual scripts we were able to include material that addressed the actual scenarios that young people had described" (Participant [P.] PSABH).

Ethnographies were also conducted as part of the needs assessment in HP4RY, which helped in identifying cultural vulnerabilities to HIV infection addressed in the programme. Furthermore, the usefulness of ethnographies in identifying young people's sexual behaviours was highlighted in MkV because of secrecy surrounding sexual relationships in sub-Saharan Africa. Overall, then, culturally-relevant ethnography, and development and application of sexual scripts prior to intervention design may improve effectiveness of school-based sexual health interventions in sub-Saharan Africa.

Intervention Mapping Step 2: Programme Outcomes and Objectives; Logic Model of Change

All the cases included in this study, except SBRHE, clearly specified aims to include one of the following aims: prevention of STIs, prevention of HIV and/or pregnancy prevention, as recommended in the Analysis Framework (Recommendation 2). So defining objectives did not differentiate between effective and ineffective interventions.

In addition, to the behaviour patterns directly associated with sexual health (e.g., abstinence, reduced number of sexual partners, condom use etc.) (Recommendation 3), some of the effective interventions targeted other behaviours. These included: communication with parents and teachers about sexuality and HIV/AIDs (PSABH); helping students to assists each other in avoiding sex (PSABH); gender roles, cultural beliefs and dominant traditions that influence sexuality (HP4RY); and substance use and productive use of leisure or free time (HealthWise). This pattern may suggest that targeting the wider cultural determinants of sexual health, rather than sexual behaviour alone, is important to the effectiveness of school-based intervention. However, the RDSP intervention, which was ineffective, also addressed self-awareness, communication and gender issues so wider targeting is not a guarantee of success.

All the cases used a logic model and/or behaviour change theory to inform programme design and evaluation (Recommendation 4). However, three of the four 'effective' interventions (PSABH, HP4RY, HealthWise) used theories set within ecological models that accounted for interpersonal and environmental factors. This was emphasised during interviews: *"Given the sexual context of HIV infection, we knew we had to work with the communities as well as the schools and parents. Bandura's theory set within an ecological framework seemed the best model to explain our expectations, as opposed to models such as Health Belief Models or other Learning Models which tended to focus on the individual and their ability to manage their behaviour in isolation from community norms and influences."* (P. PSABH). Therefore, theoretical models set within ecological frameworks as theoretical underpinning school-based sexual health education interventions in sub-Saharan Africa may be optimal to developing helpful logic models.

Intervention Mapping Step 3: Programme Design

Interventions that identified and addressed multiple psychosocial risks factors, such as beliefs likely to promote risky sexual practices, seemed to be more likely to be effective (Recommendation 5). Evidence of this was seen in three of the effective cases (PSABH, HP4RY and HealthWise) and, moreover, the MkV intervention was found to have limited effectiveness on biomedical markers, in part due to failure to address some of these factors. Hence, the importance of addressing psychosocial risk factors in school-based sexual health education can be emphasised. Psychosocial risk factors identified across cases could be classified into:

a. Cultural beliefs and practices: these include taboos around adult-child sex communication (PSABH, HP4RY, RDSP) and showing affection in sexual relationships (PSABH, HP4RY, HealthWise). Misinformation/lack of information on HIV/AIDS (PSABH), HIV perceived as 'not real' and associated with witchcraft 'night disease' (HP4RY, MkV), and the belief that abstaining from sex will lead to accumulation of sperm with consequent health consequences like abdominal cramps (SBRHE), and sex as food for the vagina or penis (HP4RY). Contradictory beliefs around sexuality and condoms (PSABH,

MkV) including the idea that condoms do not fit well and hence, get stuck in the vagina (HP4RY), and that pregnancy cannot occur after having sex once. Similarly the belief that blood will run in the head (madness) if one do not engage in sex, or that people who do not have sexual relations are abnormal. Misleading preventive beliefs included the idea that consuming certain soft drinks can prevent pregnancy and STIs, that lying on one's abdomen after sexual intercourse can prevent pregnancy and that oral contraception can protect from STIs (SATZ). Additionally, the low status of young people in communities was seen as a cultural barrier to effective interventions that target young people (MkV).

b. Economic pressures: these include exchanging sex for favours (gifts, money, grades) (PSABH, HP4RY, MkV, RDSP) and economic dependence of women on men (MkV). Teenage pregnancy is sometimes seen as a misfortune for the young woman and her family due to increase financial burden and ruining of future marriage prospects or on the other hand, as triumph because it proves fertility and provides economic gain if the father is wealthy (HP4RY). Family complicity in early sex (PSABH), including parental pressures to engage in sex for material favours (SBRHE).

c. Gender roles: These include peer pressure to engage in sex especially for young women (SBRHE, HealthWise), and peer stigmatisation of sexually inexperienced young men and young men who insist on condom use (HealthWise). Sex was also seen as rite of passage into adulthood for young men (HP4RY).

Both the effective and ineffective interventions except SBRHE were said to be designed to be sustainable within available resources (e.g., local infrastructures, school capacity) and community values (Recommendation 6). Therefore, while such sustainable development is crucial to long-term implementation with fidelity, these considerations did not differentiate between effective and ineffective interventions included here.

Evidence of consideration of the developmental age of participants and sexual experience when designing interventions (Recommendation 7) was found in three of the effective interventions (PSABH, HP4RY, HealthWise) and was absent in one of the ineffective interventions (RDSP). This was also emphasised in interviews: *"There are those who have never had sex, there are those who have had sex, so we made sure that the message fitted into whatever situation the students find themselves. For those who have had sex we said 'Well, it is okay, you can still practise secondary abstinence.'"* (P. SBRHE.). Similarly, three of the effective interventions (PSABH, MkV, HealthWise) and one of the ineffective interventions (RDSP) adopted their curricula from previous successful programmes (Recommendation 8).

Intervention Mapping Step 4: Programme production

The four effective interventions and two of the ineffective interventions (SATZ and RDSP) involved wide ranges of stakeholders with different expertise in behaviour change theory, young people's sexual behaviours, STI/HIV education, school curriculum development, intervention design and evaluation, and cultural norms as recommended in the framework (Recommendation 9). The importance of this multidisciplinary approach was also emphasised during interviews: *"I really think it helps strengthen any intervention if it is a multi-disciplinary effort."* (P. HealthWise). Fewer stakeholders were involved in one of the ineffective interventions (SBRHE).

Both the effective and ineffective interventions employed multiple activities and teaching methods (Recommendation 11). However, only the effective interventions (PSABH, MkV, HealthWise, HP4RY) explicitly matched specified activities with change techniques (Recommendation 10). For instance, in HP4RY, knowledge and awareness were provided through seminars, group presentations, drama, poems and songs. Critical thinking to change local beliefs and normative beliefs that negatively affect sexual behaviours were addressed using drama, debate and moonlight dance.

Both effective and ineffective interventions curricula were not abstinent-only (Recommendation 12), addressed education to increase HIV/STI knowledge (Recommendation 13) and did not induce HIV/STI fear (Recommendation 17). Three of the effective interventions (HP4RY, MkV, HealthWise) and two of the ineffective interventions (SATZ, RDSP) included behavioural skills training (e.g., how to get and use condoms) and negotiation skills training on communication on condom use (Recommendations 15 and 16, respectively). Evidence of such training were not found in PSABH and SBRHE. The curricula of all the interventions, except SBRHE, included attitudinal and motivational arguments that encourage positive

outcomes e.g., early diagnosis and treatment of STI/HIV (Recommendation 14) and arranged topics in a logical sequence (Recommendation 18).   Finally, lessons or topics in the curricula were spread over the period of two to three years in the effective interventions while in the ineffective interventions, they were delivered in less than one year (Recommendation 21). Overall then, while recommendations 12 to 18 are undoubtedly important to effective intervention design, evidence from this study, did not demonstrate that implementation of these recommendations differentiated between effective and ineffective school-based, HIV-preventive interventions delivered in sub-Saharan Africa.

Two effective (MkV, HealthWise) and one ineffective (RDSP) intervention included school-based or school-linked adolescent-friendly health centres (Recommendation 19). Similarly, the HP4RY worked with community patent medicine stores to ensure provision of condoms. All the four effective cases provided interventions beyond school environment and/or activities in the community to improve young people's sexual health (Recommendation 20). The PSABH intervention mobilised communities so that they would not create barriers to implementation and introduced educational activities to local festivals. The HP4RY intervention had community activities targeting out of school students, parents, older residents and elders. The MkV intervention had three other components including community mobilisations to encourage acceptance of the programme by parents and other community members; provision of adolescent-friendly health services; and social marketing and distribution of condoms. The HealthWise intervention provided students with information on where to get additional sexual information in their communities and where to do recreational activities. The RDSP intervention on the other hand, had a community component but the school component was implemented only in the first year of the programme because of political barriers: *"we only worked in schools for the first year and it came out of school. It was not in school for very much of the time"* (P. RDSP). This may imply that extensive and integrated intervention targeting both schools and the communities in which they operate is likely to optimise effectiveness.

Intervention Mapping Step 5: Programme Implementation Plan

In three of the effective interventions (PSABH, HP4RY, MkV) and two of the ineffective interventions (RDSP, SBRHE) pre-delivery consultations with school staff and parents were important to successful implementation (Recommendation 22). This was emphasised on interviews: *"I would say community support for the intervention despite the fact that it dealt with very difficult topics of sexuality with upper primary school children. This was not something that parents, religious leaders, communities, teachers are really keen on, but there was enthusiasm among the teachers, parents, religious leaders, among everyone and this became an intervention that was owned by communities and I think that was what contributed to its success more than precisely than what was taught"* (P. PSABH).

All cases received some support from appropriate school authorities for the interventions as recommend in the framework (Recommendation 23). This was emphasised as key to successful implementation during interviews: *"we have got a lot of teachers' buy in and principal support, I think those were the critical issues that the teachers were very enthusiastic about the programme"* (P. HealthWise). Similarly, all the interventions, except HP4RY, were pilot tested (recommendation 24). All of the effective and one of the ineffective interventions (SATZ) were delivered into existing curricula that were already present in school policy (Recommendation 25). The importance of this was also emphasised during interviews: *"implementation is much easier if you can embed an intervention into the school programme, and make it an examinable topic, so that it is taken seriously by both the teachers and the students, and design it well"* (P. MkV).

All the cases provided training and some support to their facilitators (Recommendation 26) so this did not differentiate between the effective and ineffective interventions. Similarly, it was not possible to judge whether interventions delivered by trained adult educators were more effective than peer educators (Recommendation 27), because none of the interventions was peer-led. However, three of the effective cases (PSABH, HP4RH, MkV) were delivered by teachers with some support of peers or young people that served as peers. The importance of the synergy between teachers and peer educators was highlighted in the SBRHE case, where the most positive effects were observed in schools with the combination of facilitators. *"And of*

course our results show that it is better you have an intervention where the teachers and the peer educators work in synergy and the results show that is the best form of intervention" (P. SBRHE).

In all the cases, activities appealing to the students were employed to enhance engagement (Recommendation 28). In two of the 'effective' interventions (PSABH, MkV) and one 'ineffective' (SBRHE), teachers felt personal benefits of developing their skills from participating in the programmes (recommendation 29). All the effective and two of the ineffective interventions (SATZ, SBRHE) had some form of leader/s who oversaw activities during implementation (Recommendation 30). Finally, fidelity of implementation (Recommendation 31) varied among schools with programmes largely implemented as intended in one effective (MkV) and one ineffective (SATZ) intervention. Thus fidelity of implementation is likely to be a criterion of effectiveness when the intervention is optimal but may matter less with sub-optimal interventions, including those that are limited in ecological scope.

Intervention Mapping Step 6: Evaluation Plan

All the cases were evaluated using multiple methods utilising both quantitative and qualitative data (Recommendation 31) and participants emphasised the importance of using mixed methods in evaluation: *"There was huge advantage to using both quantitative and qualitative approaches in the evaluations. I would like to emphasise the importance of the process evaluation because we were able to modify the intervention and improve it as we went along"* (P. MkV).

All the cases measured short- and long-term behavioural outcomes (Recommendation 33) but only one effective (MkV) and one ineffective (RSDP) intervention measured STIs/or pregnancy. Similarly, all the cases involved teachers and students in their evaluation, but only two effective interventions (MkV, PSABH) employed external or independent evaluators (Recommendation 34).   All the 'effective' interventions were implemented and evaluated over a long time period (more than 2 years) (Recommendation 35). However, the three 'ineffective' interventions were implemented and/or evaluated for less than one year (school component of RDSP, SATZ, SBRHE).

DISCUSSION

This study identified factors that may be associated with effective development, implementation and evaluation of school-based sexual health interventions based on evidence from seven interventions implemented and evaluated in five sub-Saharan African countries. An in-depth multiple case study was conducted utilising data from published and unpublished projects documents as well as discussions with investigators about factors associated with effectiveness or ineffectiveness of their interventions. An Analysis Framework comprising 35 recommendations from evidence synthesis studies provided the bases for the analyses. This provided a robust scrutiny of the inclusion or exclusion of recommended intervention and evaluation features across seven unique interventions, each with broadly the same behaviour change aim. In addition to confirming the usefulness of the 35 recommendations in improving interventions, six key features that may be associated with effectiveness were identified, namely:

1) Ethnography of young people sexual behaviours and other contextual factors that influence such behaviours, and development of sexual scripts during needs assessment;
2) Theoretical models set within ecological frameworks that address environmental and psychosocial risks factors as theoretical underpinning interventions;
3) Matching intervention activities with change techniques;
4) School- and community-based approach;
5) Combination of teachers and peers as facilitators; and
6) Duration of implementation and evaluation.

In sub-Saharan Africa, there is little open communication about adolescents' sexual relationships and such communication is often seen as a taboo (Bastien, Kajula, & Muhwezi, 2011). This may mean that young people do not openly report their sexual activities for fear of disapproval, so limiting the capacity of surveys and interviews to elicit real-world sexual behaviour patterns and antecedents. Therefore, sexual

health needs assessment may be improved by including ethnography, especially if conducted by young people where the observers live over time in the targeted communities. In addition, Sexual Scripts research conducted as part of needs assessment can better specify situations and activities that lead to sexual encounters. Sexuality research using 'scripts' suggests that sexual activities occur in a given sequence (Frith & Kitzinger, 2001). This can identify context-specific points for intervention and effective ways to derail risky scripts and, thereby, improve effectiveness of school-based sexual health interventions.

Perhaps particularly, but not exclusively, in sub-Saharan Africa, young people's sexual decisions are culturally shaped and collective rather than individual and independent so that external influences (e.g., peer and community pressures) may be especially important (Wood & Rolleri, 2014). This, together with other environmental influences, renders an ecological approach most appropriate. Ecological modelling characterises individual behaviour patterns contextualised within their social environment addressing personal, interpersonal, organisational, community and public policy factors that maintain and support undesired behaviours (McLeroy, Bibeau, Steckler, & Glanz, 1988). Moreover, within this approach the more comprehensive the targeting of psychosocial risks factors the more effective the intervention is likely to be. These include cultural beliefs and practices, economic pressures and gender roles.

The importance of external influences on young people sexual health outcomes in sub-Saharan Africa was further emphasised by the finding that interventions including community activities (in addition to school curricula) were more effective. Interventions with school- and community-based components were found to have the largest impact on HIV risky behaviours in low- and middle-income countries (Fonner, Armstrong, Kennedy, O'Reilly, & Sweat, 2014). Community-based components include intervention activities beyond school environment such as adolescent-friendly health services, condom provision, community mobilisation for programme support and activities targeting out of school young people and parents.

While all interventions studied here used logic models to identify modifiable determinants of targeted behaviour patterns and employed multiple activities and teaching methods (as recommended), only the effective interventions provided evidence of matching change techniques included in intervention activities to logic models developed during the design stage. This suggests that more precise linking of mechanisms of change identified in logic models to specific change techniques within interventions may optimise effectiveness.

School-based sexual health interventions delivered by teachers in synergy with peer educators are more likely to be successful than teachers-only. The only evaluation among the cases that compared the relative effectiveness of teacher-and-peers delivery to teachers or peers-only concluded that teachers and student peer educators can reinforce and complement one another and, thereby, enhance effectiveness. The two groups can develop a sense of partnership and accountability whereby each challenge the other to perform well in their roles (Ajuwon & Brieger, 2007).

Finally, it is worth emphasising that school-based sexual health education interventions were more effective when implemented and evaluated for at least two academic sessions or years. A longer intervention duration is likely to reach more students and to facilitate repeated exposure for individual participants. All the effective interventions in this study were implemented as on-going curricula so, if effective and sustainable, could have long-term impact. These observations are consistent with the evidence that successful maintenance of behaviour change, more generally requires longer term intervention. For example, physical activity and/or dietary interventions have been found to be more effective in promoting maintenance of behaviour change if implemented for more than 24 weeks (Fjeldsoe, Neuhaus, Winkler, & Eakin, 2011).

This multi-case review has a number of limitations that should be considered when applying our findings. First, the classification of the cases into 'effective' and 'ineffective' would have been more robust if other outcomes, in addition to self-reported condom use were considered. We did not find enough cases evaluated in terms of biological outcomes to employ such outcomes (Sani et al., 2016). Nonetheless,

condom use is a good indicator for sexual behaviour in the absence of more objective biomarkers, and it has been shown to be strongly associated with reduce STI incidence (Shew et al., 1997). Second, all the seven cases were implemented in only five sub-Saharan African countries, which challenges our claim to generalise to the subcontinent. However, considering the richness of the cases in terms size and strategic locations (West Africa, East Africa and Southern Africa), it could be argued that insights from these cases are relevant more widely than these five countries. Third, one of the authors (CM) was an investigator on one of the case (SATZ), which could have introduced bias but, we were mindful of this and none of the other three authors was involved in any of the cases. Fourth, some the cases were implemented sometime ago and therefore, responses from the investigator may be subject to recall bias. However, triangulation of data from multiple sources (documents and interviews) will have enhanced the validity of our findings. Furthermore, having investigators to validate findings from analyses of documents of their cases also adds credibility to the results.

CONCLUSION

School-based sexual health education is an essential tool for improving young people sexual health and is cost-effective in preventing STI/HIV if implemented in combination with other approaches (Hogan, Baltussen, Hayashi, Lauer, & Salomon, 2005). The effectiveness of such interventions could be improved in sub-Saharan Africa if designers and implementers consider a series of research-based recommendations, and pay particular attention to the recommendations differentiating effective and ineffective interventions reviewed here. This study advanced our understanding of the range of design, implementation and evaluation characteristics that can and should be considered when designing such interventions. Our results show that more effective interventions can be distinguished from less effective ones in relation to inclusion/exclusion of specific design, implementation and evaluation features, so recommending careful inclusion of such features in future intervention design.

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APPENDIX

Table 1: Overview of included interventions (cases)

Intervention (Case)	Country	Size
Primary School Action for Better Health (PSABH)	Kenya	80 Primary Schools Some Communities 3940 Students
School- and Community-Based HIV Prevention Interventions with Junior Secondary School Students in Edo State, Nigeria (HP4RY)	Nigeria	30 High Schools 10 Communities 5201 Students
School-based Reproductive Health Education Program in Rural South Western, Nigeria (SBRHE)	Nigeria	4 High Schools 1029 Students
Health Wise South Africa (HealthWise)	South Africa	70 High Schools 2383 Students (wave 1)
Promoting sexual and reproductive health. School-based HIV/AIDS intervention in Sub-Saharan Africa (SATZ)	South Africa and Tanzania	56 High Schools (South Africa) 24 Primary Schools (Tanzania) 12139 Students
MEMA Kwa Vijana intervention (MkV)	Tanzania	62 Primary Schools 18 Health Facilities 10 Communities 13814 Students
The *Regai Dzive Shiri* Project (RDSP)	Zimbabwe	82 High Schools 30 Communities 3960 Students

Table 2: Project documents identified and number of interviews conducted

Case	Documents	Interviews
PSABH	5 Published Journal Articles, 1 Project Documents, 1 School Health Activity Guide, 1 Training Manual, 5 Newsletters, 2 Poems/Songs, 3 Posters, 3 Unpublished Articles	1
HP4RY	7 Published Journal Articles, 2 Projects Reports, 1 PowerPoint slide, 1 School Curriculum	1
SBRHE	1 Published Journal Article, 1 Thesis Chapter	1
HealthWise	10 Published Journal Articles	3
SATZ	8 Published Journal Articles, 1 Project Proposal, 3 Students' Workbooks, 4 Teachers' Manuals	4
MkV	30 Published Journal Articles, 8 Books/Chapters, 4 Policy Briefing Papers	4
RDSP	4 Published Journal Articles	1

Table 3: Analysis Framework

Intervention Mapping Step 1: Logic Model of the Problem (needs assessment)
Needs and asset assessment of the target participants (Denford et al., 2016; Kirby et al., 2006; Sani et al., 2016): This may involves review of survey data (STD/HIV data, pregnancy data, adolescent sexual behaviour data etc.). Focus groups or interviews with adolescents and adults working in areas of reproductive health may also be conducted. This would provide information on prevalence of sexual behaviours and factors affecting those behaviours in the population.
Intervention Mapping Step 2: Programme Outcomes and Objectives; Logic Model of Change
Concentrate on clear health goals (Kirby et al., 2006) or tactically communicate aim as health goals to avoid unending debate on the legitimacy of the intervention (Paul-Ebhohimhen et al., 2008): The aim of the curriculum should address at least one of these reproductive health goals; prevention of STI, prevention of HIV and/or pregnancy. Focused on specific behaviours that would lead to health goals (Kirby et al., 2006) and specify multiple measurable behavioural targets/outcomes (Denford et al., 2016): This involves selecting a specific behaviour that lead to the health goal(s) above and giving specific information on what might lead to it and how to avoid it. Specific behaviours that would lead to STI/HIV prevention for example include; abstinence, reduced frequency of sex, reduced number of partners, condom use, STI testing and treatment, HIV testing and treatment. It used a logic model approach (Denford et al., 2016; Kirby et al., 2006) or theory-based (Gallant & Maticka-Tyndale, 2004; Kaaya et al., 2002; Sani et al., 2016): The use of model that clearly shows links between the health goal(s), behaviours, determinants of the behaviours and intervention activities that would lead to desired change in the determinants. Some developers may not use a formal model but a discussion on the four components of a logic model (goals, behaviours, determinants, activities) is enough to suggest it was used.
Intervention Mapping Step 3: Programme Design: Identifying regulatory processes that maintain current behaviour and developing effective change techniques that are theory-based and practical to modify the behaviours: intervention is likely to be successful if;
Intervention identifies and addresses multiple risks factors that can lead to behaviours (Denford et al., 2016; Kirby et al., 2006): Effective programme identify psychosocial risk and protective factors, and develop activities to address them. Effective curriculum addresses one

or more of the following factors: Knowledge including methods of prevention of STIs, HIV and pregnancy; perception of STI/HIV risks; personal norms about sex and abstinence; attitudes and perceived barriers towards condom use; perception of peer norms about sex and sexual behaviours; self-efficacy to use condom, refuse sex, avoid STI/HIV risk; intention to avoid sex, use condom, reduce number of partners and reduce frequency of sex; communication about sex, condoms and contraception with parents and other adults; avoidance of places and conditions that may lead to sex etc.

Activities are designed to be consistent with community values and available resources (Denford et al., 2016; Gallant & Maticka-Tyndale, 2004; Kirby et al., 2006). Community norms may include beliefs about sex, condom use or abstinence. Organizational capacity may include teachers' skills, time, equipment or funding.

Activities employed are appropriate to youth's developmental age and sexual experience (Denford et al., 2016; Kirby et al., 2006).

Adopting from previous effective programmes, where appropriate (Sani et al., 2016).

Intervention Mapping Step 4: Programme production: intervention is more likely to be effective if;

It involved key stakeholders (Denford et al., 2016; Kirby et al., 2006; Paul-Ebhohimhen et al., 2008; Sani et al., 2016) and negotiated content where necessary (Pearson et al., 2015). People from different backgrounds and expertise particularly in areas of behaviour change theory, adolescent and young adults' sexual behaviour, STI/HIV education, intervention design and evaluation, and cultural norms.

. It involved multiple activities matching specified mechanism with behaviour change techniques (Denford et al., 2016; Kirby et al., 2006). Effective intervention include multiple activities to address each of the factors mentioned in (5) above.

. It employed multiple teaching methods that address each factors, make youth personalise the information and employed teaching methods aiming to change the target risks (Denford et al., 2016; Kirby et al., 2006). Effective intervention includes a combination of activities appropriate in the community that involve the youth and help them personalise the information. These activities may include short lectures, class discussion, small group works, role plays, stories, condom demonstrations, problem-solving activities etc.

. It does not include abstinence only content (Denford et al., 2016).

. It includes education to increase HIV/STI knowledge (Denford et al., 2016).

. It includes attitudinal and motivational arguments that encourage positive outcomes e.g., HIV testing (Denford et al., 2016; Kaaya et al., 2002).

. It includes behavioural skills training for condom use including ability to get and use condoms (Denford et al., 2016; Kaaya et al., 2002; Paul-Ebhohimhen et al., 2008; Sani et al., 2016).

. It includes negotiation skills training for condom targeting condom communication and use (Denford et al., 2016).

. It does not induce HIV/STI fear (Denford et al., 2016).

. Topics and activities are covered in a logical sequence (first, basic information on HIV/STD/Pregnancy, followed by discussion of behaviours to reduce vulnerability/knowledge, values, attitudes, barriers, and finally provide protective skills) (Denford et al., 2016; Kirby et al., 2006)

. It includes school-based or school linked adolescent-friendly health centres (Denford et al., 2016; Sani et al., 2016).

. It involves community activities outside school environment (Sani et al., 2016).

. It is of adequate intensity and duration (Denford et al., 2016; Paul-Ebhohimhen et al., 2008).

Intervention Mapping Step 5: Programme Implementation Plan: this is likely to be successful if it involves;

. Pre-delivery consultation with school staff and parents (Pearson et al., 2015).

. Secured at least some support from appropriate authorities such as ministries of health and education, school authorities and community leaders (Denford et al., 2016; Kirby et al., 2006; Pearson et al., 2015).

. Piloting the programme (Denford et al., 2016; Kirby et al., 2006) to test the feasibility of the programme and make necessary adjustments before formal implementation.

. Policy and institutional anchoring (Pearson et al., 2015). Inclusion of the programme into school policy documents and aligning the goals of the intervention to the overall goal of the school is necessary for successful implementation.

. Training of educators, and providing monitoring supervision and support (Gallant & Maticka-Tyndale, 2004; Kirby et al., 2006; Sani et al., 2016): Selecting educators particularly those with background in health education and having plan in place to monitor, supervise and support them.

. Trained educators as facilitators instead of peers for peer-led interventions (Denford et al., 2016; Paul-Ebhohimhen et al., 2008).

. Students' engagement to ensure programme is appealing to them as well as stretching their understanding of health issues that may be beyond their experience (Pearson et al., 2015).

. Teachers and students should feel a benefit from participating in the programme e.g., transferrable skills (Pearson et al., 2015)

. Leadership (Pearson et al., 2015): appointment of project co-ordinator, leader or co-ordination team to ensure successful implementation.

. Implementation of all activities as planned (fidelity) (Denford et al., 2016; Kirby et al., 2006; Sani et al., 2016).

Intervention Mapping Step 6: Evaluation Plan

. Multiple methods (Mũkoma & Flisher, 2004): Quantitative and qualitative methods of evaluation that evaluate processes and outcomes should be employed.

. Short-and-long term outcomes including health outcomes (Denford et al., 2016; Kaaya et al., 2002) and contextual outcomes should be measured (Mũkoma & Flisher, 2004).

. Combination of people directly involved in the programme (e.g., Students, teachers and parents) together with an external evaluators in evaluation (Mũkoma & Flisher, 2004).

. Long-term implementation and evaluation is necessary to detect long-term outcome (Mũkoma & Flisher, 2004).

Table 4: Implementation of recommendations across cases

Case	Recommendations Implemented	Total Score (out of 35)
PSABH	1-14, 15*, 17, 18, 20-27, 28*, 29, 30, 31*, 32, 33*, 34, 35.	31
HP4RY	1-7, 9, 10-16, 17*, 18, 19*, 20-23, 25-27, 28*, 30, 31, 32*, 33*, 34.	28.5
MkV	1-14, 15*, 16*, 17-27, 28*, 29-35.	33.5
HealthWise	1-21, 22*, 23-25, 26*, 27, 28*, 30, 31*, 32, 33*, 34*, 35.	31
SATZ	1-7, 9, 10*, 11-18, 19*, 20*, 22*, 23*, 24-27, 28*, 30-32, 33*, 34*, 35*.	27.5
RDSP	1-5, 7-14, 15*, 16*, 17-24, 26, 27, 28*, 31*, 32, 33, 34*, 35,	28.5
SBRHE	1, 3-5, 7, 10*, 11-14, 17, 21, 22, 23*, 26, 27, 28*, 29, 30, 32, 33*, 34*, 35*.	20

*features partially implemented