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Preventing sexually transmitted infections among adolescents: an assessment of ecological approaches and study methods

Jean A. Shoveller*, Joy L. Johnson, Daphné M. Savoy and W. A. Wia Pietersma

University of British Columbia, Canada

Most primary prevention research has attempted to explain sexual health outcomes, such as sexually transmitted infections, by focusing on individual characteristics (e.g. age), qualities (e.g. knowledge levels), and risk behaviour (e.g. unprotected intercourse). Emerging evidence indicates that population-level health outcomes are unlikely to be explained adequately as an aggregate of such individual-level factors. Rather, approaches that move beyond individualistic frameworks and adopt more ecological approaches may hold promise for promoting sexual health at the population level. This paper assessed the degree to which ecological approaches were integrated into empirical research regarding interventions to prevent sexually transmitted infections among adolescents. The paper also assessed the scientific rigour of the 35 intervention reports included in this review. Most \( n = 31 \) reports focused exclusively on the micro-level (e.g. individual knowledge and attitudes) issues. No studies accounted for macro-level concerns (e.g. socio-cultural influences). Three reports were rated as methodologically ‘strong,’ 11 were of moderate quality and 21 reports were rated as ‘weak.’ Most sexual health interventions targeting adolescents have focused nearly exclusively on individual risk, but have failed to yield encouraging results in terms of behaviour change or reducing disease burden in this population. More attention should be paid to ecological approaches and new study methods should be explored.

Introduction

Many adolescents in North America experience serious health and social problems related to sexually transmitted infections (STIs). Treatment is available for most STIs but prevention of these diseases is the preferable option, since they can have serious, long-term, health and social implications. While the early to mid-1990s witnessed declining rates of some STIs, such as chlamydia, syphilis and gonorrhoea,
more recent surveillance evidence indicates that STIs appear to be on the rise and continue to pose risks to health and reproductive capacity, particularly among young people.

The 1998/99 Canadian Sexually Transmitted Diseases (STDs) Surveillance Report shows that females of 15–19 years of age represented 38% of all female cases of *Chlamydia trachomatis* (Health Canada, 1998/1999). The overall age distribution of gonorrhoea in Canada in 1998 shows the highest concentrations in 15-year-old to 19-year-old females (80 per 100,000). In Canada, an estimated 20–40% of chlamydia infections develop into pelvic inflammatory disease. More than 1400 females aged 15–19 years were hospitalised for pelvic inflammatory disease during 1996/97 (Health Canada, 1998/1999). Pelvic inflammatory disease is linked with infertility and it can be a painful and debilitating disease (MacDonald & Brunham, 1997). Although the situation is more catastrophic in some countries than in others, STI prevention interventions are re-emerging as an important priority for public health and preventive medicine in many industrialised countries.

The magnitude and seriousness of this threat to adolescent health is further enhanced if one considers that the number of *reported* cases of STIs under-represents the actual cases, since many instances of reportable STIs go undetected. In addition, some common STIs, such as human papillomavirus and herpes simplex virus, are not legally reportable to public health authorities in many jurisdictions. Research on HIV/AIDS risk has also shown that people with STIs have a two-fold to five-fold increased risk for HIV infection (CDC, 1998; Mertz *et al.*, 1998). It is thought that STIs facilitate HIV transmission via direct, biological mechanisms as well as through concomitant individual risk behaviour (Stamm *et al.*, 1988; Fleming & Wasserheit, 1999; Silversides, 1999).

Most primary prevention studies and theories have attempted to explain sexual health outcomes within and across population groups by focusing on individual characteristics (e.g. age), qualities (e.g. knowledge levels), and risk behaviour (e.g. unprotected sexual intercourse). While these factors are important to understanding sexual health outcomes, emerging evidence indicates that health outcomes at the population level are unlikely to be explained adequately as an aggregate of such individual level factors (Ketting & Visser, 1994; Macintyre & Ellaway, 2000). Changes in knowledge and attitudes at the individual level provide a necessary, but insufficient, basis for long-term behaviour change or improved sexual health outcomes at the population level (Wasserheit & Aral, 1996; Gunatilake, 1998). Research and intervention approaches that move beyond exclusively individualistic frameworks and adopt a more ecological approach hold promise for promoting sexual health at the population level (Yen & Syme, 1999; Glass, 2000; Bosma, van de Mheen *et al.*, 2001).

Ecological theory asserts that a reciprocal and dynamic inter-relationship exists between the individual and subsystems of the environment (Bronfenbrenner, 1979). From an ecological perspective, behaviour and health outcomes are inextricably linked with micro-level, meso-level and macro-level influences that exist within the contexts in which people reside. At the most basic level, the micro-level, the analysis
pertains to individual characteristics, activities, roles and interpersonal relationships in a given setting. Micro-level interventions contend that STI risk behaviour is largely a product of individual decision-making. These types of interventions conventionally approach sex education in ways that emphasise (and privilege) the provision of information about reproduction and STI protection that can then be put to use within the context of individual decision-making.

The meso-level examines relations among groups across settings, while the macro-level pertains to socio-cultural, systemic and policy-level influences that typically originate with public institutions. Meso-level preventive interventions recognise the influences that relationships at the dyadic or small group level affect STI risk-taking behaviour. These intervention approaches typically rely on small social networks, peer influences and membership in social groups or organisations as a means to describe the network within which individuals take risks. While sex education efforts that aim to address the meso-level attempt to speak to individual decision-making within the contexts of social relations (e.g. deconstructing perceived sexual norms of peers), these educational undertakings often fail to account for (and respond to) broader influences (i.e. macro-level) that also help to construct the context within which young people enact their decisions about reducing risk for STIs.

Macro-level interventions focus on social structures and institutions as well as social and cultural norms across communities. Policy changes, social movements and provision of accessible and youth-friendly sexual health services are examples of macro-level interventions. From a macro-level perspective, the focus of sexual education would be as likely to include high-level policy-makers, opinion leaders and the media, elected officials, service providers and others who are positioned to affect the institutional and social structures that ultimately set the scope within which meso-level and micro-level sex education efforts are enacted.

The central assumption of ecological approaches to sex education is that micro-level, meso-level and macro-level factors concomitantly affect health behaviour and outcomes. By addressing the inter-relationships between the micro-level, meso-level and macro-level influences that exist within the contexts in which young people reside, ecological approaches to sex education would encompass the individual (e.g. knowledge, decision-making), their social relations (e.g. sexual partners, peers, families), as well as their social and institutional contexts (e.g. sexual health services, community norms). Ecological approaches to sex education necessarily connotes moving beyond an exclusive focus on ‘sex ed’ in school or ‘the talk’ within the family setting; ecological approaches challenge these stereotypical representations of sex education. By extending sex education beyond customary information-provision approaches and settings, ecological approaches to sex education attempt to address an array of sexual health determinants, ranging from the individual level to the structural.

Ecological theory and approaches are not new (McLeroy et al., 1988, 1993; Green et al., 1996; Richard et al., 1996; Green & Kreuter, 1999) and are widely used by health promotion and preventive medicine practitioners. However, concerns have been raised regarding the capacity of empirical research to keep pace with theoretical
and practice-based advances towards ecological perspectives (Sallis & Owen, 1997). While reviews and summaries of the literature related to STI prevention have been conducted (Aral, 1994; Oakley et al., 1995; Aral et al., 1996; Aral & Peterman, 1998), the current article addresses a gap in the existing literature, since no systematic literature review evaluating the ecological quality of the empirical evidence regarding interventions to prevent STIs has been published previously. Waldo and Coates (2000) called upon HIV prevention scientists to ‘expand their efforts to conceptualise the determinants of HIV risk behaviour at multiple levels,’ (p. S25) arguing that the adoption of ecological approaches to intervention and research is critical to advancing prevention science and practice in this area.

In addition, researchers studying adolescent pregnancy prevention also have called for more theory-driven research and programming that adopts an ecological perspective (Corcoran, 2000). Two recent reviews regarding teen pregnancy prevention (Kirby, 2001; Kirby & Miller, 2002) provide evidence from a substantial body of literature that supports our proposed rationale for ecological intervention approaches to promote sexual health among young people. While neither of the reviews on teen pregnancy interventions uses the language of ‘ecological approaches,’ the findings of both reports exhort the benefits of addressing teen pregnancy’s ‘sexual’ (e.g. individual attitudes toward contraception use) and ‘non-sexual’ antecedents—those that are manifested in an individual’s family, school and community contexts (e.g. disadvantaged family life, poverty, detachment from scholastic achievement, work and other social institutions).

Using an ecological framework, we present a critical assessment of 35 published studies (1995–2001) conducted in industrialised countries (including the USA, the United Kingdom and Norway) that evaluated the effectiveness of behaviour change interventions to reduce STI risk among adolescents aged 12–18 years. We also include an evaluation of the methodological quality of these studies. The objectives are not to determine which interventions are most useful for promoting behaviour change, but rather to ascertain the degree to which ecological approaches are employed in this substantive area and to assess the methodological quality of the published studies included in the review. Results of the review are used to inform recommendations regarding strategic directions for enhancing ecological approaches to interventions and for improving study design, data collection and measurement of outcomes, and/or funding or publishing standards related to interventions that aim to reduce STI risk among adolescents.

**Methods**

Relevant published literature was identified through a search of the following electronic databases: Medline, HealthStar and AIDSLINE. Additional relevant published reports were located by hand searching selected journals and reference lists from retrieved articles. Key word searches used the terms ‘sexually transmitted disease,’ ‘prevention,’ ‘adolescents’ and ‘intervention study/studies.’ Study eligibility criteria included published in English between 1995 and June 2001,
primary research reports that used quantitative designs, and a focus on STI risk behaviours among adolescents aged 12–18 years. If study samples included 50% or more participants aged 12–18 years, then they were evaluated in this review. In addition, in some reports it was impossible to determine whether this criterion was met because participant age was insufficiently described or omitted. In these cases, the reports were excluded. We did not investigate other related studies to determine whether age (or other socio-demographic characteristics) was reported in earlier baseline papers. The review included reports of primary prevention intervention studies associated with STI prevention conducted in industrialised countries.

Although a significant and important body of literature pertains to pregnancy prevention (Corcoran, 1999), our review focused solely on reports related to STI prevention (including HIV/AIDS). Interventions that prevent STIs also are effective for preventing pregnancy and many interventions adopt a combined approach to address both outcomes; however, not all pregnancy prevention approaches provide protection from STIs. Therefore, if an intervention report focused exclusively on pregnancy prevention (e.g. oral contraceptives) and did not combine these methods with the use of female and/or male condoms, it was excluded from this analysis. In order to increase the comparability of studies, those studies that focused exclusively on knowledge or attitudinal change were excluded from the analysis (Young et al., 2000). This decision was also informed by the perspective that changes in knowledge levels and attitudes may be necessary, but are not sufficient conditions, to promote the adoption of behaviour that may enhance STI prevention. Studies that focused exclusively on contact tracing or other traditional STI control approaches (e.g. STI screening) also were excluded from this review to avoid potential problems in comparing studies whose purpose was secondary or tertiary prevention with those studies whose purpose was primary prevention (e.g. risk reduction behaviour change in schools or communities). It must be acknowledged that treatment and contact tracing provide an important role in STI prevention, particularly regarding prevention of re-infection. This is an important area that warrants separate review.

Potentially eligible publications were reviewed to determine study eligibility. All authors read each study and applied two separate evaluation schemes to each eligible study. First, studies were evaluated to determine the degree to which they integrated an ecological approach using the definition of multi-level interventions presented earlier. The studies were subsequently classified into three categories: multi-level interventions (micro-level, meso-level, macro-level), bi-level interventions (any two levels), and uni-level interventions (micro-level only).

Classic evidence classification systems, such as those described in the Cochrane Handbook (Clarke & Oxman, 2001) could not be used to review the multiple types of studies included in this analysis. Therefore, the scientific rigour of eligible studies was assessed using criteria similar to those developed and applied in a recent review of HIV/AIDS prevention interventions (Shoveller & Pietersma, 2002) and outlined in Table 1. The authors read each study and used these criteria to assess the methodological quality of each study. A value between 0 and 4 was assigned for each
An overall scientific rigor score was computed for each study (perfect score was 28 points) by summing the criteria-based scores. Each of the four authors independently rated each criterion for each study and then the four authors worked together until consensus was reached regarding an overall score. Together, they engaged in debate and discussion until they came to agreement regarding an overall score for each study. No agreement scores were calculated. Studies were rated as ‘strong’ if they had an overall score of 23 or higher, a ‘moderate’ rating was assigned if a study had an overall score between 18 and 22, and studies with overall scores less than 18 were rated as ‘weak.’

<table>
<thead>
<tr>
<th>Element</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study design</td>
<td>Experimental design. 4/4</td>
</tr>
<tr>
<td></td>
<td>Quasi-experimental with comparison group. 2/4</td>
</tr>
<tr>
<td></td>
<td>One-group pre- and post-test. 1/4</td>
</tr>
<tr>
<td>Sample size</td>
<td>Sample size calculation reported and justified and/or sample size adequate to produce statistically significant results. 4/4</td>
</tr>
<tr>
<td></td>
<td>Sample size reported and power discussed in cases where non-significant results are reported. 2/4</td>
</tr>
<tr>
<td></td>
<td>Sample size reported, but not justified or discussed. 1/4</td>
</tr>
<tr>
<td>Description of intervention</td>
<td>Provided enough information to replicate the intervention. 4/4</td>
</tr>
<tr>
<td></td>
<td>Provided some information on the setting, programme components, and the delivery of the intervention. 2/4</td>
</tr>
<tr>
<td></td>
<td>Provided no information on the intervention. 0/4</td>
</tr>
<tr>
<td>Theoretical basis for intervention</td>
<td>Theoretical basis for intervention described in detail and appropriately applied. 4/4</td>
</tr>
<tr>
<td></td>
<td>Some information provided on theoretical basis for intervention and/or theory not fully applied. 2/4</td>
</tr>
<tr>
<td></td>
<td>No information on the theoretical basis for the intervention provided and/or theory inappropriately applied. 0/4</td>
</tr>
<tr>
<td>Data collection tools</td>
<td>Data collection tools shown to have high levels of validity and reliability. 4/4</td>
</tr>
<tr>
<td></td>
<td>Data collection tools discussed and/or shown to have moderate levels of validity and reliability. 3/4</td>
</tr>
<tr>
<td></td>
<td>Validity and reliability of data collection tools not discussed or shown to be low. 0/4</td>
</tr>
<tr>
<td>Long-term follow-up</td>
<td>Reported on follow-up at 12 or more months post-intervention. 4/4</td>
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<tr>
<td></td>
<td>Reported on follow-up at 6–11 months post-intervention. 3/4</td>
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<td></td>
<td>Reported on follow-up at three to five months post-intervention. 2/4</td>
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<tr>
<td></td>
<td>Reported on follow-up at one to two months post-intervention. 1/4</td>
</tr>
<tr>
<td></td>
<td>No reported, long-term follow-up, except immediate post-intervention. 0/4</td>
</tr>
<tr>
<td>Attrition and withdrawal</td>
<td>Information provided regarding the proportion of study participants who withdrew and/or were lost to follow-up and an explanation provided. 4/4</td>
</tr>
<tr>
<td></td>
<td>Information provided regarding the proportion of study participants who withdrew and/or were lost to follow-up, but no explanation provided. 3/4</td>
</tr>
<tr>
<td></td>
<td>Insufficient information provided regarding withdrawals or attrition. 1/4</td>
</tr>
<tr>
<td></td>
<td>No information provided regarding withdrawals or attrition. 0/4</td>
</tr>
</tbody>
</table>
Results

Searches yielded 584 citations; 549 articles were eliminated from further review. Many (n = 146) studies were not conducted in an industrialised country, 347 studies did not measure risk behaviour or health outcomes, and 56 studies pertained primarily to adults over the age of 18 years. In total, 35 studies were found to be eligible for inclusion in this review. Since many studies remain unpublished, we acknowledge that the sample of studies may be biased in that it did not include all research in the field.

Integration of ecological approaches

Classification of the studies revealed that there have been no multi-level (micro-level, meso-level, macro-level) interventions reported. No interventions addressed macro-level influences. Four reports addressed interventions that focused on both the micro-level and meso-level (Weeks et al., 1997; Coyle et al., 1999; O’Donnell et al., 1999; Basen-Engquist et al., 2001) and the remaining 31 reports focused exclusively on the micro-level.

To gain a better understanding of the ways in which ecological approaches have been incorporated in previous interventions, it is instructive to examine in detail the characteristics of the four reports that focused on both the micro-levels and meso-levels. Two of the four reports that focused on both micro-level and meso-level factors are based on the same intervention—the Safer Choices Project (Coyle et al., 1999; Basen-Engquist et al., 2001). One report describes the short-term impact of the intervention at seven months post-baseline, while the other examines school-wide effects of the programme 31 months after baseline. The Safer Choices Project addressed micro-level factors through intervention components such as ninth-grade and tenth-grade classroom activities. The intervention also included meso-level programme components that facilitated personal interactions between students, teachers, peers, parents and local community resources and service providers. For example, parents and students were expected to complete homework activities together to facilitate communication regarding HIV, other STIs, and pregnancy prevention. Parents were also invited to participate as members of school-based health promotion councils that planned additional parent–student activities. In the short-term (seven-month follow-up), there were no statistically significant differences on the primary outcomes of interest (incidence of sexual initiation and unprotected intercourse) between students enrolled in participating intervention schools in comparison with students enrolled in schools where this programme was not offered. Results at 31 months post-baseline indicated that the programme may have contributed to a decrease in unprotected sex, but was not effective in preventing students from initiating sexual activity for the first time. These two studies demonstrate the complexities of implementing and evaluating an intervention that addresses both micro-levels and meso-levels. As is the case with many health promotion programmes, it is difficult to identify causal links between specific programme components and study
outcomes. Moreover, these reports fail to illuminate the synergistic effects across intervention levels.

O’Donnell et al. (1999) described the effectiveness of the Reach For Health Community Youth Service Learning Program in reducing early and unprotected sex among urban middle school students. This bi-level intervention included a curriculum designed for seventh and eighth graders (micro-level) as well as a meso-level component that provided community placements for students in a variety of health settings in order to promote empowering interactions among students and other members of their community. For example, students would visit nursing homes and read to elderly people or assist with recreational activities at child-care centres. It appears that students who participated in the community service component of the intervention were less likely to report recent sexual intercourse at follow-up than students in the control condition. While the intervention offers an innovative approach, the report fails to provide convincing evidence regarding the theoretical underpinnings of the meso-level intervention and the mechanisms by which the various programme components complement one another. Clear articulation of the ecological elements involved in this intervention would help to strengthen the study.

Weeks et al. (1997) evaluated the impact of parent–student interaction on students in a school-based AIDS prevention programme. The bi-level intervention included classroom instruction and activities for seventh, eighth and ninth graders and a parent-interactive component in which students were required to complete homework assignments with their parents. The homework assignment included interviews between parents and students regarding issues such as teen pregnancy, drug use, educational plans and future goals. Parents were also provided with information about how to talk with their children about these issues and were encouraged to interact with their children’s schools through parent meetings and other special events organised to promote AIDS prevention. Evaluation results showed that parent interaction did not provide a significantly enhanced intervention effect and that neither the experimental nor the control groups experienced any significant changes in behaviour as a result of the intervention. Although we recognise that parent–child interaction is an important facet of healthy adolescent development, the use of a homework model is limited in scope. The complexities of adolescent sexual health warrant more far-reaching and innovative intervention approaches that may hold broader appeal for teens and parents.

While all four of these reports included intervention components that focused on the micro-levels and meso-levels, none addressed macro-level factors. In addition, none of the reports refer to ecological theory nor do the interventions address the issue of interactions among micro-levels, meso-levels and macro-levels. The four reports that included both micro-level and meso-level factors all describe the methodological challenges in evaluating multi-level interventions, which may provide insight into the reasons why ecological approaches have not been applied and adopted widely in practice, despite having been promoted through the theoretical literature. While ecological approaches hold promise for advancing the
field of adolescent sexual health promotion, studies that are restricted to the examination of the effects of one level can continue to make important contributions. In order to make such contributions, all studies also must be sufficiently rigorous.

Study quality assessments

We undertook the study quality assessments in order to elucidate the methodological strengths and weaknesses of the published literature in this area. Table 2 presents a list of the studies included in the review and summarises the study quality scores assigned to eligible studies. The most common research design used to evaluate interventions was a quasi-experimental design \( (n = 13) \); 11 studies used experimental designs with comparison groups and 11 studies relied on one-group pre-post test designs. Less than one-half of the studies reviewed \( (n = 16) \) reported sample size and discussed power issues where non-significant results occurred. Over 50% of studies \( (n = 20) \) provided enough information to replicate the intervention. Sixteen studies described in detail the theoretical basis for their interventions, while in 19 other studies the theoretical basis was less well described and/or not fully applied. Most studies \( (n = 32) \) either did not discuss the validity and reliability of their data collection tools or used tools with moderate to low validity and reliability scores. Many studies \( (n = 19) \) reported on follow-up at 12 months or more post-intervention. Although about two-thirds \( (n = 23) \) of studies assessed and reported on study attrition and withdrawal, 12 studies failed to provide sufficient information on this aspect of study quality.

Overall, of the 35 studies reviewed, three were rated as methodologically ‘strong,’ 11 were of moderate quality and 21 studies were rated as ‘weak.’ All three of the studies that were rated as ‘strong’ (Jemmott et al., 1998, 1999; Coyle et al., 1999) used experimental designs (randomised controlled trials), provided detailed descriptions of their interventions (i.e. sufficient detail to replicate the basic scope and content of the intervention) and descriptive information about study ‘dropouts’ and explanations regarding the proportion of study participants who withdrew and/or were lost to follow-up. For example, Jemmott et al. (1999) dedicated two paragraphs at the outset of their ‘Results’ section to explain issues related to study attrition; Coyle et al.’s (1999) report featured a table that describes the five programme components of the ‘Safer Choices Program’ and detailed the features of each programme component (e.g. the curriculum and staff development component is composed of a sequential 20-session classroom curriculum for ninth-grade and tenth-grade students, which is implemented by the teacher and includes the use of in-class peer leaders to help students engage in small-group role plays). Of these three studies, two (Jemmott et al., 1998, 1999) provided a sample size calculation and/or justified their sample size (e.g. discussed sample size calculations in terms of alpha values and estimated effect sizes), described in detail the theoretical basis for their interventions (e.g. provided a detailed discussion of previously published literature that established the conceptual framework for their studies) and
Table 2. Results of scientific rigour assessment

<table>
<thead>
<tr>
<th>Author (year of publication)</th>
<th>Study design</th>
<th>Sample size</th>
<th>Description of intervention</th>
<th>Theoretical basis for intervention</th>
<th>Data collection tools</th>
<th>Long-term follow-up</th>
<th>Attrition and withdrawal</th>
<th>Total score (out of 28)</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aarons et al. (2000)</td>
<td>2</td>
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<td>4</td>
<td>0</td>
<td>4</td>
<td>1</td>
<td>15</td>
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<td>Basen-Engquist et al. (2001)</td>
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<td>2</td>
<td>2</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>0</td>
<td>17</td>
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<td>4</td>
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<td>2</td>
<td>4</td>
<td>19</td>
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<td>Hanna et al. (1997)</td>
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<th>Description of intervention</th>
<th>Theoretical basis for intervention</th>
<th>Data collection tools</th>
<th>Long-term follow-up</th>
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<sup>a</sup>The design also included a quasi-experimental element.<br>
<sup>b</sup>A separate component of the study had only eight months of follow-up.
demonstrated that their data collection tools had high levels of validity and reliability (e.g. both reports provided detailed descriptions of the question content, response options and psychometric properties of the measures used in their studies). One of the three methodologically strongest studies (Jemmott III et al., 1998) reported on follow-ups at 3, 6 and 12 months post-intervention.

**Suggestions for advancing research and practice**

The review undertaken here aimed to describe the ecological nature of the published evidence regarding interventions to prevent STIs among adolescents, and to assess the methodological features of published studies in this area. Although researchers working in the field of youth sexual health have made considerable advances towards conducting high-quality intervention evaluations, several challenges remain. First and foremost is the need to move towards multi-level, ecological approaches to interventions that include a focus on the macro-level (e.g. policy interventions) to support risk-reducing contexts in which youth experiment with and develop sexual behaviour patterns (Aral, 1994).

The assumptions of traditional approaches to preventing STIs among adolescents need to be unpacked in terms of the suppositions about gender, sexuality, class and race that are embedded in most STI prevention interventions (Bay-Cheng, 2003). Considerable theoretical and empirical work needs to be conducted in order to come to terms with the ‘upstream,’ structural-level forces (MacIntyre & Ellaway, 2000) or the non-sexual antecedents (Kirby, 2001) that impact on adolescent STI rates. Ecological interventions would need to be designed to address micro-level, meso-level and macro-level factors, and therefore would need to be operationalised at these three levels.

For example, ecological interventions would need to address individual knowledge levels and attitudes (i.e. micro-level issues), while concomitantly tackling issues that are more embedded in meso-level (e.g. relationships with parents, academic and vocational achievements) and macro-level structures (e.g. poverty, social norms, availability of youth sexual health services). Thus, in addition to providing individual teens with information about STI risks and how to avoid them, ecologically oriented STI prevention programmes would also address the factors that put young people at risk of such risks. At a minimum, in order to be recognised as ecological (and moreover to be more effective), health services interventions would need to address issues at the macro-level, including ensuring that youth had easy and no-cost (or at least low-cost) access to both female and male condoms as well as access to youth-friendly and confidential STI testing and treatment services. As one example, the establishment of community-based and/or school-based, youth-friendly clinics may have good potential for adopting and enacting ecological interventions (e.g. they could concomitantly provide STI information, counselling for individuals, couples or families, as well as STI testing and treatment services and condoms). Professionals working in youth clinics could also act as opinion leaders within schools and communities to affect positive changes in social norms that put youth at
higher risk of STIs (e.g. youth sex being portrayed as a taboo subject). At the very broadest level, professionals, parents and youth who are affiliated with such clinics may also emerge as advocates regarding macro-level interventions that would address other, non-sexual antecedents to STIs (e.g. poverty, disengagement from community and school life).

It is these meso-level and macro-level issues that are too often overlooked in conventional sex education—perhaps because such issues are situated in complex or politically sensitive domains that are difficult to shift within the short timeframes that are accorded to most sex education interventions. However, sex educators are well positioned to take action that would support the design and implementation of STI prevention programming that builds on youth’s naturally occurring social relations (e.g. peers, family, sex partners) to educate the public, policy-makers and other opinion leaders (e.g. the media, religious groups) about the benefits of constructing socially progressive policies and social norms so that young people can more safely and effectively enact their decisions about reducing risk for STIs. While such an undertaking will demand that both researchers and practitioners (e.g. educators, health care professionals) acknowledge and redress current problematising of adolescent sex as a cause of a disease or even death (Shoveller et al., 2004), practitioners and researchers can draw on lessons learned from the teen pregnancy literature (Kirby, 2001; Kirby & Miller, 2002) and be hopeful that such change is possible.¹

To date, most research and interventions in this substantive area have languished in highly individualistic approaches and have been based on the assumption that behaviour is fully reflective of actual STI risk. Previous evaluations and commentaries on the quality of the published evidence and the general state of intervention research in this substantive area have also raised questions regarding the effectiveness of research efforts designed to inform strategies to prevent STIs. Oakley et al. (1995) identified and critically reviewed 68 publications (1982–1994). Few (n = 18) intervention studies met the rigorous methodological quality criteria applied by Oakley and her colleagues, who concluded that publication standards should be raised to encourage researchers to adopt more rigorous research approaches to intervention evaluation. In addition, while calls for a population health approach to the prevention of STIs have generated controversy within the field, they appear to have led to further research and more advanced thinking about the causal mechanisms by which social, environmental and behavioural factors interact to influence STI risk (Aral et al., 1996; Aral & Peterman, 1998; Fishbein & Jarvis, 2000; Schachter, 2000).

Recent evidence regarding the lack of predictive power reflected by micro-level factors (e.g. individual behaviour change) and the importance of macro-level influences (e.g. the community where one lives, the ethnic group one belongs to) (Peterman et al., 2000) supports our assertion that additional work is needed to develop and rigorously test more ecologically based approaches to promoting adolescent sexual health at the community level. As has been suggested elsewhere, research is needed to determine how well ecological interventions perform in
comparison with more traditional approaches (Sallis & Owen, 1997). The field could benefit significantly from the development of objective measures of macro-level influences as well as measures to assess the effect of interactions among micro-level, meso-level and macro-level forces. While we recognise that adopting ecological approaches poses numerous and sometimes serious challenges to the current capacity of traditional, empirical research and conventional intervention models, there is an urgent need to stimulate research and practice based on ecological approaches in order to enhance the potential to achieve important health gains at the population level.

Additionally, gains remain to be made in the methodological quality of research in this substantive area. Despite our observation that sample size and statistical power are major concerns, we suggest that before moving towards the use of larger, probability-based samples, researchers should pay more attention to internal validity concerns, particularly issues related to study design, data collection tools and use of theory. The three studies that were rated as methodologically ‘strong’ in this review (Jemmott et al., 1998, 1999; Coyle et al., 1999), used either true experimental or quasi-experimental designs, employed data collection tools with good to excellent psychometric properties, and appropriately and/or fully applied the theoretical framework for their study. Moreover, the complexities of understanding the interplay between micro-level, meso-level and macro-level forces affecting adolescent STIs would also be well-suited to qualitative investigations, as these have the capacity to tap into and uncover rich descriptions and analyses of the social practices and structures related to adolescents’ experiences with STIs.

Reviewers for research agencies and journals could help raise the standards in all these areas. Intervention evaluation proposals and/or manuscripts that emphasise ecological approaches and include appropriate study methodologies should receive priority as a means to initiate progress on this front. It is clear that not every intervention can feasibly include multiple strategies at multiple levels; however, well-targeted multi-level interventions warrant the attention of researchers and practice leaders. Concurrently, research agencies could support the development of comprehensive training approaches to help improve capacity to adopt and rigorously evaluate ecological interventions.

A first step towards improving research capacity for ecological approaches involves clearly conceptualising the relevant ecological variables, particularly at the macro-level, that affect adolescent sexual health, and more particularly STI prevention among young people (e.g. social norms, poverty and access to STI testing, treatment and other health services). From a study design perspective, ecological approaches make it difficult to rely on ‘experimental’ and ‘quasi-experimental’ designs. For example, communities and organisations are constantly changing in ways that are typically beyond the control of the researcher; hence, it is nearly impossible for the researcher to maintain sufficient control over the intervention setting, study participants or implementation to meet the traditional criteria for rigor as prescribed by the post-positivist paradigm. Because ecological approaches address multiple levels of influence, and moreover the interactions among such levels, newly emerging
mixed-method approaches (Greene, 1998) and multi-level designs (Marmot, 2000) may prove useful in addressing these challenges.

Evaluations of ecological approaches to STI prevention may benefit from a mixing of methods that are derived from alternatives to the positivist paradigm, including critical theory, constructivism and participatory research (Green et al., 2000). Attending to multiple levels of context (micro, meso, and macro) and assessing the ways in which they affect programme outcomes is likely to provide an impetus for researchers and programme designers to pursue designs that incorporate both qualitative and quantitative research strategies (Creswell et al., 2004). Since most interventions are intended to move beyond efficacy and into the effectiveness realm, the complexities of ‘real-world’ conditions demand sophisticated and responsive techniques that allow the evaluator to gather data on multiple levels (e.g. the individual, group and institutional or structural levels). Empirical research that attends to both the ‘subjective experience and social location’ of study participants (Pavis et al., 1998, p. 1409) aims to provide a more full account of the multiple levels of factors that affect health behaviour and outcomes; to achieve such aims, researchers using mixed-methods approaches tend to draw on multiple, and sometimes disparate, data sources (e.g. surveys, observations, in-depth interviews) and methodological paradigms (each with their own ontological and epistemological assumptions). While not without challenges (Teddlie & Tashakkori, 2003; Johnstone, 2004), mixed-method approaches to evaluation offer up an array of methodologies (e.g. case studies, ethnography, action research) that can be combined to best meet the informational needs of different stakeholder groups, ranging from ‘macro program- and cost-effectiveness questions of policy makers to the micro questions of meaning for individual participants’ (Greene, 1998, p. 375).

Researchers and programme designers concerned with STI prevention interventions also should consider the usefulness of adopting multi-level modelling schemes in order to better assess group effects (e.g. families, schools, clinics, neighbourhoods) that result from the hierarchical and clustered nature of the quantitative data incorporated into their analyses (Hox, 1995; Duncan et al., 1996). Multi-level approaches also provide evaluation studies, which often are forced by practical considerations to sample at the group level (e.g. classroom, school, clinic, census area), with sufficiently sophisticated statistical techniques to ensure that the unit of sampling corresponds with the unit of analysis. By using multi-level modelling techniques to analytically account for nested and grouped effects (e.g. examining data at the individual student, classroom and neighbourhood levels simultaneously), such evaluations could provide more precise comparisons between intervention and control conditions and more realistically account for relationships across micro-levels, meso-levels and macro-levels of social organisation (Goldstein, 1998).

**Conclusions**

Significant improvements in interventions to promote the sexual health of adolescents are required to achieve more long-term success in this area. While
ecological approaches are not a panacea, they warrant further attention. These approaches are not new to health promotion or preventive medicine and questions have been raised concerning the feasibility of integrating this stance with the realities of intervention planning and evaluation (McLeroy et al., 1988; Green et al., 1996; Richard et al., 1996; Green & Kreuter, 1999). However, the complexities of ecological theory demand sophisticated conceptualisations, study designs and analytic tools that have yet to be fully applied in relation to interventions that are designed to prevent STIs among young people (Minkler & Wallerstein, 1999; Green et al., 2000).

Acknowledgements

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Notes

1. The reader is advised to refer online (http://www.stopteenpregnancy.com/) for a description of the Carerra Adolescent Pregnancy Prevention Program to learn more about how this programme is addressing teen pregnancy at multiple levels of intervention.

2. A misplaced focus on the individual as the unit of analysis is not a problem limited to school-based studies, as Altman and Bland (1997) point out in their critical review of clinical studies.

3. We direct the interested reader to the Centre for a mass of information and resources.

References


