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1 **The Health Promoting Schools framework:**
2 **Known unknowns and an agenda for future research**

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1 **Author Contributions**

2 RL wrote the protocol, performed the bibliographical searches, identified the studies,
3 extracted data, planned the analyses and produced the first draft of this manuscript. RC was
4 the Principal Investigator and had the original idea for the review, obtained funding for it and
5 oversaw the review process. She was also involved in drafting the protocol, identifying
6 studies, extracting data, and producing this manuscript. DM, CB, SM, KK, LG and EW helped
7 identify studies, extracted data, and provided critical input into the protocol, review and this
8 manuscript.

9 **Conflicts of Interest**

10 Kelli Komro was an investigator in three studies (Perry et al. 1996; Perry et al. 2003;
11 Komro et al. 2008) included in the review; she was not involved in data extraction or
12 analysis of any data from these studies. Elizabeth Waters and Lisa Gibbs are investigators in
13 an on-going study identified as potentially eligible for this review. Rebecca Langford has
14 undertaken consultancy work for the WHO as part of a Delphi exercise into mental health
15 and psychosocial support in humanitarian settings. Rona Campbell is a Director of DECIPHer
16 Impact, a not-for-profit company wholly owned by the Universities of Bristol and Cardiff,
17 which licences and supports the roll out of evidence-based health promotion interventions.
18 She receives modest Director's fees which are paid into a University account and spent on
19 research related items. No conflict of interest is declared for any other co-authors.

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21

1 **Abstract**

2 The World Health Organization’s Health Promoting Schools (HPS) framework is
3 a whole-school approach to promoting health which recognises the intrinsic relationship
4 between health and education. Our recent Cochrane systematic review found HPS
5 interventions produced improvements in a number of student health outcomes. Here we
6 reflect on what this review was *not* able to tell us: in other words, what evidence is missing
7 with regard to the HPS approach. Few HPS interventions engage with schools’ ‘core business’
8 by examining impacts on educational outcomes. Current evidence is dominated by obesity
9 interventions, with most studies conducted in children rather than adolescents. Evidence is
10 lacking for outcomes such as mental or sexual health, substance use and violence. Activities
11 to engage families and communities are currently weak and unlikely to effect behavioral
12 change. The HPS approach is largely absent in low-income settings, despite its potential in
13 meeting children’s basic health needs. Intervention theories are insufficiently complex, often
14 ignoring upstream determinants of health. Few studies provide evidence on intervention
15 sustainability or cost-effectiveness, nor in-depth contextual or process data. We set out an
16 agenda for future school health promotion research, considering implications for key
17 stakeholders; namely national governments, research funders, academics and schools.

18

1 Introduction

2 Children and young people matter for public health (Davies, 2013; Sawyer et al., 2012).
3 Experiences during the early years influence life-course trajectories (CSDH, 2008), with 70%
4 of adult premature deaths largely being caused by behaviors developed in childhood (WHO,
5 2009). Ensuring children have the best start in life has enormous implications for health,
6 society and the economy (Marmot et al., 2010).

7 Schools provide an obvious setting for health promotion for two reasons. First,
8 children spend a large proportion of their childhood within schools. Second, health and
9 education are intrinsically linked. Improvements in health bring educational benefits (Durlak,
10 Weissberg, Dymnicki, Taylor, & Schellinger, 2011; Farahmand, Grant, Polo, & Duffy, 2011;
11 Murray, Low, Hollis, Cross, & Davis, 2007); and the greater your education, the better your
12 health later in life (Feinstein, Sabates, Anderson, Sorhaindo, & Hammond, 2006; Higgins,
13 Lavin, & Metcalfe, 2008).

14 The World Health Organization's Health Promoting Schools framework (HPS)
15 advocates a whole-school approach to promoting health (WHO, 1997). While definitions vary
16 (IUHPE, 2010; Jamison et al., 1998; Langford et al., 2014; Lister-Sharp, Chapman, Stewart-
17 Brown, & Sowden, 1999; Lynagh, Schofield, & Sanson-Fisher, 1997; Nutbeam, 1992; St Leger,
18 1998), the HPS framework comprises three broad elements. First, health education is
19 addressed within the school curriculum. Second, health and well-being are promoted through
20 changes to the schools' social and/or physical environment. Third, schools engage with
21 families and communities to reinforce health messages outside the school environment.

1 We recently reviewed evidence for the effectiveness of this approach in improving
2 student health and academic outcomes (Langford et al., 2014; Langford, Bonell, Jones,
3 Poulou, et al., 2015). Focusing on studies with rigorous evaluation designs, we found the HPS
4 approach to be effective at improving a number of student health outcomes.

5 However there are many gaps in our understanding of this approach due to limitations
6 in the available literature. Here we identify and critique what is currently missing from the
7 evidence base. We conclude with a research agenda for Health Promoting Schools and
8 suggestions for how this might be realised.

9 **Methods**

10 ***WHO Health Promoting Schools Cochrane systematic review***

11 The review focused on cluster randomised trials comprising students aged 4-18 years.
12 To be eligible for inclusion interventions had to demonstrate active engagement in all three
13 HPS domains, namely: curriculum, environment, and families/communities. We searched
14 medical, social science and educational databases, trials registries and websites to identify
15 trials in 2011 and 2013. No date or language restrictions were applied. For each study, two
16 reviewers independently extracted data pertaining to: study design and location, participant
17 characteristics, intervention details, and health and educational outcomes. Where possible
18 we conducted random-effects meta-analyses. See the full Cochrane review for full details on
19 the methods and limitations of the review (Langford et al., 2014).

1 **Results**

2 Our searches yielded 48,551 records, from which we identified 67 eligible studies.
3 Details of these interventions are presented in Table I.

4 ***Impact on health outcomes***

5 Full details of the impact of HPS interventions on health outcomes are reported
6 elsewhere (Langford et al., 2014). We provide a brief summary to provide context for this
7 paper.

8 On average, HPS interventions increased students' levels of physical activity, fitness
9 and fruit/vegetable intake. There was some evidence that physical activity interventions
10 reduced students' body mass index. Students receiving HPS interventions were less likely to
11 smoke or report being bullied. We found no evidence of effectiveness for fat intake, alcohol
12 and drug use, mental health, violence and bullying others, though few studies reported on
13 these outcomes. There was insufficient evidence to determine the effectiveness of this
14 approach for: sexual health, hand-washing, cycle helmet-use, eating disorders, sun
15 protection, oral health and academic outcomes.

16 ***Gaps in the evidence***

17 While the Cochrane review focused on examining intervention effectiveness, here we
18 identify and critique what is currently missing from the evidence base.

19 ***Impact on education***

20 Of the 67 included studies, most (n=56) did not present any educational or school-
21 related outcomes. Two studies reported math and reading test scores; one found a positive

1 effect (Snyder et al., 2010), but the other did not (Bavarian et al., 2013). Of the four studies
2 recording student absences, all reported significant reductions (Bavarian et al., 2013; Bowen
3 et al., 2007; Snyder et al., 2010; Talaat et al., 2011). Seven studies presented non-academic
4 outcomes such as school attachment or perception of school climate, with mixed results.

5 An underpinning principle of the HPS framework is that in order to learn effectively
6 children must first be healthy (WHO, 1997). Yet, our review has highlighted that within
7 otherwise robust evaluations of the HPS framework, educational impacts are rarely reported.

8 Although it was originally envisaged that responsibility for creating Health Promoting
9 Schools must lie with educationalists (Young & Williams, 1989), this has not been realised.
10 Rather, research has been driven by those working in the health sector (Mohammadi,
11 Rowling, & Nutbeam, 2010; St Leger & Nutbeam, 2000). Consequently, within interventions
12 identified by this review, there is rarely discussion concerning the primary aim of schools (to
13 educate) and how health initiatives might contribute to this objective.

14 This represents a missed opportunity. The WHO has highlighted the lack of attention
15 paid to the impact of child health on educational outcomes in high-income countries (Suhrcke
16 & de Paz Nieves, 2011). Substance use, obesity/over-weight, mental health and sleep
17 disorders were found to negatively impact educational attainment, while physical activity
18 may enhance student performance (Suhrcke & de Paz Nieves, 2011). These observational
19 data are limited by methodological issues such as reverse causality and residual confounding.
20 However, other reviews including RCT trial data provide good evidence that child health
21 affects educational outcomes (Basch, 2011; Durlak et al., 2011; Farahmand et al., 2011;
22 Hoagwood et al., 2007; Murray et al., 2007).

1 This lack of engagement with the fundamental ‘core business’ of schools limits the
2 potential of the HPS framework. A whole-school approach requires substantial commitment
3 from schools to be effective. This is more likely to be achieved if schools can see the direct
4 benefits to students via increased performance, higher attendance, improved concentration
5 and better behavior.

6 Data on attendance, attainment and disciplinary sanctions are routinely collected by
7 schools, local authorities and government departments. However, negotiating access to these
8 can be challenging. Collaborating with schools early on in the research process and providing
9 appropriate administrative support should aid this process. In addition, the development of
10 anonymised data linkage programs (Lyons et al., 2009) offer powerful tools for assessing
11 broader educational, social and economic impacts of school-based interventions.

12 ***The HPS evidence composition***

13 Half of the included studies focused on obesity, cardiovascular disease or diabetes
14 (Table I), by seeking to increase physical activity (n=4), improve nutrition (n=12) or a
15 combination of both (n=18).

16 This focus on physical activity and nutrition interventions reflects growing global
17 concern over childhood obesity (WHO, 2000; WHO, 2016). However, some health topics seem
18 more intuitively amenable to the HPS approach. Given that children spend roughly half their
19 waking hours and eat (at least) one meal a day at school, this setting is an obvious choice for
20 intervention. Activities fitting the ‘environment’ criterion in these interventions were often
21 the most concrete: improving the quality of school lunches; restricting sale of unhealthy
22 foods; incorporating physical activity into the school day. It is less immediately obvious how

1 to change the school environment to improve sexual health outcomes or reduce substance
2 use since these behaviors largely occur outside of school (Basen-Engquist et al., 2001; Beets
3 et al., 2009; Li et al., 2011). The few HPS studies focusing on these areas show it is possible to
4 create such changes, usually by promoting engagement and fostering a different ethos and
5 culture within schools. However, theories articulating how schools can impact on these areas
6 are more complex, less direct and thus more challenging to operationalize (Bonell, Fletcher,
7 & McCambridge, 2007; Fletcher, Bonell, Sorhaindo, & Strange, 2009).

8 Few HPS interventions focused on substance use, violence, mental or sexual health,
9 hampering our ability to draw any clear conclusions. More rigorous trials are needed in these
10 areas. Observational evidence suggests these outcomes do vary between schools and appear
11 to be influenced by the degree to which schools engage students educationally and pastorally
12 (Bonell, Parry, et al., 2013).

13 ***Evidence of age bias***

14 Our review identified a split between the focus of interventions at different ages.
15 Physical activity/nutrition interventions were more likely to target younger (≤ 12 years) than
16 older (< 12 years) children (24 vs. 6 studies); four studies targeted both. By contrast, substance
17 use, sexual health, mental health and violence interventions were largely conducted with
18 students aged 12+ years (16 vs. 4 studies).

19 Focusing on these latter topics in high schools might seem appropriate; adolescence
20 is often when these behaviors begin and mental health problems emerge. However, risk
21 factors for these behaviors often arise earlier in childhood and intervening sooner might help
22 prevent their emergence in adolescence and adulthood (Greenberg, Domitrovich, &

1 Bumbarger, 2001; Jackson, Geddes, Haw, & Frank, 2012; Weare & Nind, 2011). Indeed, the
2 two trials of the *Positive Action* intervention included in the review (Beets et al., 2009; Li et
3 al., 2011) were implemented in elementary schools and showed promising evidence for a
4 number of health and school-related outcomes.

5 There is less obvious justification for the imbalance of physical activity/nutrition
6 interventions between younger and older children. Physical activity declines during
7 adolescence, particularly in young women (Allison, Adlaf, Dwyer, Lysy, & Irving, 2007; Nader,
8 Bradley, Houts, McRitchie, & O'Brien, 2008). Equally, young people gain greater freedom over
9 their food choices and how they spend their time in adolescence (Fitzgerald, Heary, Nixon, &
10 Kelly, 2010). Obesity rates in the UK among 11-15 year-olds are almost double that in children
11 aged 2-10 years (19% vs. 11%, Natcen & UCL, 2012), while in the USA over a third (35%) of
12 12-19 year-olds are overweight or obese (Ogden, Carroll, Kit, & Flegal, 2012). We found
13 positive intervention effects on BMI, physical activity, fitness and fruit/vegetable intake
14 (Langford et al., 2014), but most data were from primary/elementary schools. Another
15 Cochrane review on childhood obesity similarly reported three times as many interventions
16 in 6-12 year-olds as 13-18 year-olds (Waters et al., 2011). We urgently need more research
17 focusing on older children, given that some studies show promise in reducing BMI (Haerens
18 et al., 2006; Simon et al., 2006).

19 Our review also identified a lack of interventions (on any topic) in older adolescents.
20 Most studies focusing on 'older' students targeted 12-14 year-olds, with few targeting later
21 teenage years. The latter years of secondary/high school are when key exams are taken.
22 During these years, participating in health research may be seen as a distraction from the
23 important business of exam preparation. Yet this is also the period with the highest levels of

1 teenage substance use, violence and sexual activity (Kann et al., 2014), all of which could
2 potentially affect students' performance at school. Clearly there is a need for evidence-based
3 interventions during these years.

4 ***Family and community***

5 To be included in the review, interventions had to demonstrate action in all three HPS
6 domains. However, the family/community element of interventions appeared to be the
7 weakest of the three. In almost half of the studies activities to engage families were minimal
8 and tokenistic, relying on newsletters, one-off meetings or family homework assignments. In
9 almost every study, family engagement was low (Langford, Bonell, Jones, & Campbell, 2015).
10 Only about a quarter of interventions attempted to involve local communities through, for
11 example, media campaigns, neighborhood health action teams or lobbying councils to
12 improve neighborhoods. Unfortunately, few studies provided details on what (if any) changes
13 they brought about.

14 While children spend much of their time within the school environment, they spend
15 more time out of it. The influence of families (and the wider community) on health-related
16 knowledge, attitudes and behaviors can be profound. However, the techniques used in many
17 of these interventions to engage families were wholly inadequate and unlikely to effect
18 significant change.

19 Engaging families and communities with school initiatives is acknowledged to be
20 highly challenging (Garcia-Dominic et al., 2010; Hornby & Lafaele, 2011). Researchers should
21 consider the opportunity costs of such family involvement. Is it critical to intervention
22 success? Would schools be better off focusing resources on 'in-school' activities that are

1 easier to implement? On the other hand, the relationship between schools and their
2 communities can have a profound effect on student functioning. A convincing body of
3 evidence documents the positive effects of family involvement in schools on student
4 performance (Henderson & Mapp, 2002; Weiss, Bouffard, Bridglall, & Gordon, 2009; Wilder,
5 2014). Bryk and Schneider (2002), in particular, identified the importance of relational trust
6 between parents and teachers as a foundation for meaningful school improvement,
7 documenting how schools with low levels of parental involvement were much less likely to
8 see improvements in key outcomes such as reading and math. Schools already engage
9 parents in multiple ways to improve educational outcomes (Goodall & Vorhaus, 2011;
10 Henderson & Mapp, 2002). For example, Epstein and colleagues (2009) set out a framework
11 of six types of family/community involvement (parenting, communicating, volunteering,
12 learning at home, decision making, collaborating with community.) Capitalising on and
13 complementing these existing links could be used to strengthen health messages. One thing
14 is clear: if it is done, it must be done well. While the benefits of changes to the school
15 curriculum or environment will be felt universally across the student population, family
16 engagement in school interventions is often highly socially patterned. Without careful and
17 concerted effort to engage *all* families, this aspect of the HPS framework may increase health
18 inequities as harder-to-reach groups miss out.

19 ***Low income countries***

20 While the HPS framework is a global initiative, our review identified a paucity of
21 research conducted in low-income settings. Of the 67 included studies, all but eight were
22 conducted in high-income countries. Of these, most were conducted in middle-income
23 countries with just one in a low-income country (Tanzania).

1 Almost 90% of the world's three billion children and young people live in low- and
2 middle-income countries (United Nations, 2013); investing in research to improve their health
3 should be an urgent priority. Arguably the links between health and education are more acute
4 in such settings. The impact of malnutrition and infectious disease, for example, on children's
5 physical and cognitive development are well documented (Berkman, Lescano, Gilman, Lopez,
6 & Black, 2002; Grantham-McGregor, 1995). The HPS framework potentially has much to offer
7 in these contexts, yet rigorous evaluations of this approach have not been conducted
8 representing a huge missed opportunity for these children.

9 **Theory**

10 Within our review, all but 10 studies cited at least one theory as informing their
11 intervention. Twenty-two theoretical models were identified, with social cognitive theory
12 being most commonly cited (Table 1). Only 15 of the 67 included studies explicitly mentioned
13 the HPS framework.

14 Interventions are more likely to be successful if they are theoretically informed (NICE,
15 2007). However, interventions must use *appropriate* theories. Many complex interventions
16 are informed by insufficiently complex theories (Bonell, Fletcher, et al., 2013). Although the
17 HPS framework is intended to transform institutions, most interventions employed
18 psychological theories that focus on individual-level, rather than upstream, determinants of
19 health. Such theories often fail to understand the ways in which school culture and ethos,
20 and the relationships and identities created within schools, can profoundly affect health.

21 More complex and sociologically-informed theories are starting to emerge. Markham
22 & Aveyard (2003) and Markham (2015) focus on the ways in which schools' organisation,

1 curriculum and pedagogic practice affect students' critical reflection, sense of belonging, self-
2 esteem and ultimately their health. Bonell, Fletcher et al. (2013) similarly provide a more
3 complex theoretical model of school environment influences on student health identifying
4 four interconnecting pathways: student commitment to school; student-peer commitment;
5 student cognition and; student behaviors. Keshavarz and colleagues (2010) evaluate the value
6 of complexity theory in understanding the implementation and sustainability of school-based
7 interventions. Pound and Campbell's recent review of sociological theories of adolescent risk-
8 taking (2015) is also of particular relevance to school health research. Theories such as these,
9 used in conjunction with psychological theories, allow for more sophisticated understanding
10 of how interventions might work within the school environment.

11 ***Evaluation***

12 Our review highlighted a lack of evidence regarding intervention sustainability and
13 cost-effectiveness. With only ten studies including post-intervention follow-up we know little
14 about the sustainability of these interventions' impacts. Equally, few studies included any
15 economic evaluation. Only two studies performed cost-effectiveness evaluations, both
16 concluding they offered value for money (Kesztyüs et al., 2013; Wang et al., 2000).
17 Sustainability and cost-effectiveness are key pieces of information on which policy makers
18 make decisions about program investment and as such should be standard elements of any
19 evaluation program.

20 Most studies provided very limited descriptions of intervention elements or the
21 implementation context, making it difficult to assess their relevance in differing settings.
22 While most provided some process data, the majority used simplistic quantitative
23 assessments of fidelity and acceptability (Langford, Bonell, Jones, & Campbell, 2015) and

1 provided little insight into what worked, for whom, in what circumstances and why (Bonell,
2 Fletcher, Morton, Lorenc, & Moore, 2012; Pawson & Tilley, 1997). Hung and colleagues'
3 recent narrative review (2014) of the implementation of HPS initiatives highlights the
4 importance of these contextual and processual data. Adherence to the recently published
5 template for intervention description and replication (TIDieR) checklist (Hoffmann et al.,
6 2014), as well as the recently published process evaluation guidance (Moore et al., 2014) from
7 the UK Medical Research Council should improve the conduct and reporting of future
8 interventions.

9 **Discussion**

10 The WHO's Health Promoting Schools framework is an effective means of improving
11 a number of student health outcomes. Yet there is much we still do not know about this
12 approach and its full potential remains untapped and unevaluated.

13 Current HPS trial evidence has little to say about its potential impact on educational
14 outcomes. Neither does it speak to the 90% of children and young people living in low- and
15 middle-income countries. While HPS interventions can improve key determinants of obesity,
16 there is a paucity of evidence for its impact on other important outcomes such as substance
17 use, violence, mental health and sexual health, although other reviews including non-RCT
18 evidence have found promising effects (IUHPE, 2010). There is an unjustified division
19 between topics focused on at younger (obesity) and older (substance use, violence etc.) ages.
20 The family/community element of the HPS approach is weak and currently unlikely to foster
21 behavioral change. Interventions are also under-theorised, with a heavy reliance on

1 psychological theories. Finally, making the case for investing in the HPS approach to policy
2 makers is hampered by the lack of evidence of sustainability or cost-effectiveness.

3 By reviewing the current evidence base and identifying these gaps, we hope to inform
4 the research agenda for the HPS model in the 21st Century; our suggestions for future
5 research are set out in Box 1. We now consider the broader implications of these findings for
6 key stakeholders: namely, national governments and policy makers, research funders,
7 academic researchers and schools.

8 Given the intrinsic relationship between health and education, governments must
9 break down the siloed approach that sees departments working in isolation from (or in
10 opposition to) one another. The prevailing political rhetoric in many countries suggests
11 focusing on health distracts attention away from improving attainment, but these are
12 synergistic not antagonistic goals (Bonell et al., 2014). Health and education departments
13 share a common agenda for children and young people: creating healthy, well-educated
14 individuals who can successfully contribute to society (Langford, Bonell, Jones, Pouliou, et al.,
15 2015). Making health education a statutory part of the school curriculum, providing adequate
16 support to teachers and examining student well-being in statutory school inspections could
17 help to drive up educational standards.

18 Research funders are key stakeholders in addressing gaps in the evidence base.
19 Funders must recognise the urgent need for quality evaluations of initiatives in low-income
20 settings and invest in appropriate programs to address this gap. The enormous potential of
21 this approach for millions of children across the globe is hampered by a lack of robust
22 evidence in these areas. Collaboration between different funding bodies is also needed to
23 enable interdisciplinary research between health and education. Further, funders should

1 consider the need for longer-term evaluations, opportunities for data linkage and Phase IV
2 implementation trials.

3 Our review suggests academic researchers should critically reflect on the (often
4 implicit) assumptions that underpin their research. Should research to promote health in
5 schools be conducted by health researchers? What might the evidence base look like if
6 research had been driven by educationalists, as originally envisaged? Health promotion is only
7 likely to be widely supported in schools if it is viewed as a means to an end: a way of improving
8 educational outcomes. Future HPS research requires a shift in approach to ensure
9 interventions are developed and evaluated by both health and education researchers,
10 alongside meaningful engagement with school staff and students.

11 Finally, what does this mean for schools? Teachers are often keenly aware of the
12 relationship between health and education and deeply committed to improving student well-
13 being. Schools can have a profound influence on the health of young people; research
14 suggests the values, ethos and culture promoted in schools are critical in this regard (Bonell,
15 Parry, et al., 2013; Jamal et al., 2013). Our HPS review provides the most robust evidence to-
16 date that whole-school interventions can make a difference for student health. Our hope is
17 that such evidence will help teachers make the case for why health promotion should be an
18 integral part of schools' practice. But further, we hope that by identifying the gaps in our
19 current evidence base, schools will feel empowered to challenge researchers to ensure
20 interventions are relevant to the core business of schools: to educate the next generation.

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Table I Characteristics of the trials included in the review, by intervention focus

Intervention focus	Number of studies	Health outcomes	Countries	Target age group (range)	Duration (range)	Theories cited (Number of studies)
<i>Nutrition interventions</i> (Anderson et al., 2005; Bere, Veierod, Bjelland, & Klepp, 2006; Evans et al., 2013; Foster et al., 2008; Hoffman, Franko, Thompson, Power,	12	BMI, zBMI, fruit & vegetable intake, fat intake	Finland, Netherlands, Norway, Spain, UK, Australia, USA	5-15 years	6 months - 3 years	Health Promoting Schools framework (2), social cognitive theory (5), framework for health maintenance behavior (1), social learning theory (2), PRECEDE model of health education (1), ecological model (1)

& Stallings, 2010; Hoppu et al., 2010; Lytle et al., 2004; Nicklas, Johnson, Myers, Farris, & Cunningham, 1998; Perry et al., 1998; Radcliffe et al., 2005; Reynolds et al., 2000; te Velde et al., 2008)						
Physical Activity interventions (Eather, Morgan, & Lubans, 2013;	4	BMI, zBMI, physical activity, physical fitness	France, Switzerland, Australia	6-12 years	8 weeks to 4 years	Health Promoting Schools framework (2), social cognitive theory

Kriemler et al., 2010; Simon et al., 2006; Wen et al., 2008)						(1), competence motivation theory (1)
Physical Activity + Nutrition interventions (Arbeit et al., 1992; Brandstetter et al., 2012; Caballero et al., 2003; Colin-Ramirez et al., 2010; Crespo et al., 2012; Foster et al.,	18	BMI, zBMI, physical activity, physical fitness, fruit & vegetable intake, fat intake	Belgium, Germany, the Netherlands, Norway, Spain, UK, Australia, New Zealand, Mexico, USA	5-14 years	8 months to 3 years	Health Promoting Schools framework (2), social cognitive theory, (7) social learning theory (2), health belief model (1), structural model of health behavior (1), (socio-)ecological model (4), theory of planned behavior (2), trans-

<p>2010; Grydeland et al., 2013; Haerens et al., 2006; Jansen et al., 2011; Llargues et al., 2011; Luepker et al., 1996; Rush et al., 2012; Sahota et al., 2001; Sallis et al., 2003; Shamah Levy et al., 2012; Trevino, Hernandez, Yin, Garcia, & Hernandez, 2005;</p>						<p>theoretical model (1), organization change theory (1), ASE (attitude, social influence and self-efficacy) model (1)</p>
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<p>Trevino et al., 2004; Williamson et al., 2012)</p>						
<p>Tobacco interventions (de Vries et al., 2006 (reporting on two studies); Hamilton, Cross, Resnicow, & Hall, 2005; Perry, Stigler, Arora, & Reddy, 2009; Wen et al., 2010)</p>	<p>5</p>	<p>Tobacco</p>	<p>Denmark, Finland, India, China, Australia</p>	<p>11-15 years</p>	<p>2-3 years</p>	<p>Health Promoting Schools framework (1), social cognitive theory (1), social influences model (1), social- ecological framework (1), PRECEDE-PROCEED model (1), ASE (attitude, social influence and self- efficacy) model (2)</p>

<p>Alcohol interventions (Komro et al., 2008; Perry et al., 1996)</p>	2	Alcohol (and tobacco and drug use as secondary outcomes)	USA	11-14 years	3 years	Theory of triadic influence (1), social learning theory (1)
<p>Multiple Risk Behavior interventions* (Beets et al., 2009; Eddy, Reid, Stoolmiller, & Fetrow, 2003; Flay, Graumlich, Segawa, Burns, & Holliday, 2004; Li et al.,</p>	7	Tobacco, alcohol, drugs, violence, sexual health	USA, Australia	5-14 years	10 weeks - 6 years	Health Promoting Schools framework (1), theory of self-concept (2), theory of triadic influence (4), coercion theory (1), community organisation theory (1), social cognitive theory (1)

<p>2011; Perry et al., 2003; Schofield, Lynagh, & Mishra, 2003; Simons-Morton, Haynie, Saylor, Crump, & Chen, 2005)</p>						
<p>Sexual health interventions (Basen-Engquist et al., 2001; Ross et al., 2007)</p>	<p>2</p>	<p>Sexual health</p>	<p>USA, Tanzania</p>	<p>14+ years</p>	<p>2-3 years</p>	<p>Social cognitive theory (1), social influence theory (1), social learning theory (1), models of school change (1)</p>

<i>Mental health interventions</i> (Bond et al., 2004; Sawyer et al., 2010)	2	Mental health and well-being (+ alcohol/drug use and bullying as secondary outcomes)	Australia	13-14 years	3 years	Health Promoting Schools framework (2), attachment theory (1)
<i>Violence prevention interventions</i> (Orpinas et al., 2000; Wolfe et al., 2009)	2	Violence (and sexual health as a secondary outcome)	USA, Canada	11-15 years	15 weeks to 3 semesters	Social cognitive theory (1)
<i>Anti-bullying interventions</i>	7	Being bullied, bullying others	Belgium, Finland, The Netherlands, Australia, USA	6-15 years	9 months to 2 years	Health Promoting Schools framework (2), social cognitive theory

<p>(Cross et al., 2011; Cross et al., 2012; Fekkes, Pijpers, & Verloove- Vanhorick, 2006; Frey et al., 2005; Kärnä et al., 2013; Kärnä et al., 2011; Stevens, De Bourdeaudhuij, & Van Oost, 2000)</p>						<p>(3), (social) ecological theory (2), social control theory (1), health belief model (1), problem behavior theory (1), social learning theory (1)</p>
<p>Hand-washing interventions (Bowen et al., 2007; Talaat et al., 2011)</p>	<p>2</p>	<p>Illness from infectious disease,</p>	<p>China, Egypt</p>	<p>6-9 years</p>	<p>12 weeks to 5 months</p>	<p>None stated</p>

		attendance outcomes				
<i>Accident prevention intervention</i> (Hall, Cross, Howat, Stevenson, & Shaw, 2004)	1	Cycle-helmet use	Australia	10-11 years	2 years	Health Promoting Schools framework (1)
<i>Eating disorders intervention</i> (McVey, Tweed, & Blackmore, 2007)	1	Eating disorders, perception of body image	Canada	11-13 years	8 months to 3 years	Health Promoting Schools framework (1), ecological theory (1)
<i>Sun safety intervention</i> (Olson et al., 2007)	1	Sun safety	USA	11-14 years	3 years	Social cognitive theory (1), socio-ecological

						theory (1), protection motivation theory (1)
Oral health intervention (Tai, Jiang, Du, & Peng, 2009)	1	Oral health	China	6-7 years	3 years	Health Promoting Schools framework (1)

BMI = Body Mass Index; zBMI = Body Mass Index adjusted for sex and age.

*Multiple Risk Behavior interventions focused on multiple health outcomes with one intervention.

Box 1 Health Promoting Schools: future research agenda

Below we set out our recommendations for future research into the WHO's Health Promoting Schools framework.

Outcomes: Interventions should examine impact on educational, as well as health, outcomes (e.g. absences, attainment). Health researchers should work closely with educators to identify appropriate outcomes, and ensure adequate administrative support to enable school to collect these data.

Focus: Further research into the effectiveness of the HPS approach for substance use, sexual and mental health is needed.

Timing: Interventions could explore the effectiveness of intervening at an earlier age (primary/elementary level) to reduce substance use, or improve mental and sexual health. Interventions to tackle obesity in older children (12+ years) are needed. Equally, interventions on all topics targeting children in final years of education (15-18 years) would be of value.

Family/Community: The value of this element of the HPS framework should be explored with multi-arm, factorial evaluation designs. However, where included, the family community element needs to be strengthened, combined with concerted efforts to ensure to reduce inequities in participation and co-ordinated with efforts to address upstream determinants of health.

Settings: More interventions (on all relevant health topics) are urgently needed in low and middle-income countries.

Theory: Interventions should be informed by sufficiently complex theories that engage with institutional (not just psychological/behavioral) processes, and take account of the upstream determinants of health and health behaviors.

Evaluation: Studies should assess longer-term effectiveness by collecting outcome data after intervention completion. Economic analyses of cost-effectiveness should be included in all trials. Mixed-methods process evaluations should go beyond simple assessments of fidelity and acceptability to examine what works, for whom, in what circumstances and why. Researchers should consider the use of data linkage to assess the broader educational, social and economic impacts of school-based interventions