Interactive electronic media interventions targeted at adolescents for prevention of overweight and obesity: a rapid review

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An **Evidence Check** review brokered by the Sax Institute for the NSW Department of Health

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This rapid review was brokered by the Sax Institute.

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Contents

Glossary

Interactive electronic media interventions

Interventions delivered via computer-based programs, interactive internet sites, electronic messaging systems, email, social networking media (e.g. Facebook), e-whiteboards and related media.

Quality

Study quality was appraised using specific criteria from quality assessment checklists (see section 2.3 Study Appraisal). High quality studies were well designed interventions that met the majority of appraisal criteria.

Transtheoretical model

The transtheoretical model is a model of intentional behaviour change developed by Prochaska and DiClemente in the 1980s. The model describes the progress of health behaviour change through various stages of change (precontemplation, contemplation, preparation, action, maintenance, and termination), driven by processes of change, decisional balance, self efficacy and temptations. This theoretical model has been adopted by many interventions to promote health behaviour change.

List of abbreviations

BI:	Body image
BMI:	Body mass index
CDC:	US Centers for Disease Control and Prevention
NHMRC:	Australian Government National Health and Medical Research Council
NHS:	UK National Health Service
NIH:	US National Institutes of Health
NSW:	New South Wales
RCT:	Randomised controlled trial
SIGN:	Scottish Intercollegiate Guidelines Network
UK:	United Kingdom
US:	United States
WM:	Weight management

EXECUTIVE SUMMARY

Purpose of review

This review was commissioned by NSW Health to investigate whether interactive electronic media interventions are effective for preventing overweight and obesity in adolescents, in order to inform future directions and options for designing and implementing adolescent health promotion programs for the prevention of overweight and obesity.

Intervention evidence

Nineteen intervention studies were identified that were relevant to the scope of the review. Despite the paucity of research, the limited available studies provide some insight to assist in informing future directions for the design and implementation of adolescent overweight and obesity prevention health promotion programs.

Intervention evidence appraisal and relevance to NSW

Most adolescent overweight and obesity prevention/treatment studies demonstrate positive outcomes in participants receiving interventions incorporating electronic media. Positive outcomes include increased knowledge, changes in attitudes (e.g. increased self efficacy and reduction in weight and shape concerns), positive behaviour changes (e.g. increased physical activity, decreased skipped meals, decreased dietary fat intake, reduction in objective and subjective binge episodes, and healthier usual food choices) and reductions in body mass index (BMI) and BMI z-score. However, these results should be viewed with caution as only one of these studies was deemed high quality.

The majority of smoking interventions demonstrate positive outcomes including reductions in smoking initiation and prevalence. However of these, only one study was deemed high quality.

Research gaps in the evidence base include more well designed studies such as randomised controlled trials (RCTs), studies in non-school settings, long-term trials (>12 months), studies incorporating innovative electronic media such as social networking media and e-whiteboards, studies in Australian populations, and studies targeted towards both adolescents and their parents.

Research results should be viewed with caution as most studies were conducted in the United States (US), largely in minority populations. The direct transferability of interventions and subsequent findings into the NSW environment is unclear.

Recommendations

The following recommendations are made based on expert opinion following analysis of the strength and quality of existing evidence.

1. Further high quality Australian interventions using electronic media interventions to prevent overweight or obesity in adolescents should be conducted.
2. Consider the inclusion of an innovative electronic media intervention component in adolescent overweight and obesity prevention programs.
3. Develop interventions that specifically target the requirements of adolescents.
4. Engage adolescents in the development of any planned electronic health promotion interventions.
5. Ensure that adolescent safety and wellbeing are paramount considerations in intervention development.
6. Implement interventions using an appropriate delivery medium in an appropriate setting.
7. Develop and disseminate appropriate obesity prevention messages.
8. Conduct effective intervention evaluation, incorporating specific evaluation of the electronic intervention.

1. Background

The global prevalence of adolescent overweight and obesity is increasing[1], and it is estimated that a quarter of Australian adolescents are overweight or obese[2], making overweight and obesity one of the most common chronic disorders in this age group[3]. Excess weight in adolescence increases the risk of being overweight in adulthood[4] and can lead to a range of immediate and long-term medical and psychosocial consequences[5]. Thus, it is vital that effective health promotion programs for the prevention of overweight and obesity targeted specifically towards adolescents are developed and disseminated.

Recent advances in technology provide the opportunity to use youth friendly and potentially interactive modes of communication in health promotion interventions. Interactive media interventions are most often computer delivered, e.g. via the internet or CD-ROM. Benefits of interactive media interventions include incorporation of rich media, immediate and often tailored feedback, greater participant action and control, flexibility to participate in the program at the participants' convenience and the potential for wide program reach[6].

This review has been commissioned to address the question of whether interactive electronic media interventions are effective for preventing overweight and obesity in adolescents, in order to inform future directions and options for designing and implementing adolescent health promotion programs for the prevention of overweight and obesity.

The review briefly summarises existing systematic reviews and key research studies with expert opinion of the strength and quality of evidence. The evidence is evaluated with regards to areas of strong evidence, areas with equivocal or conflicting evidence and areas lacking evidence. The review incorporates all relevant peer reviewed literature and selected grey literature from Australia and comparable countries.

Interactive electronic media interventions for the prevention of overweight and obesity are of primary interest to the scope of this review; however, evidence from smoking prevention studies is also examined due to the potential applicability to prevention of overweight and obesity. Some interventions addressing treatment of adolescents that are already overweight or obese are included in the review, as are relevant interventions aimed at parents, and those focused on the prevention of eating disorders. Interventions that are clinically focused and involve treatment of adolescents with established medical conditions resulting from overweight and obesity, in addition to those addressing clinical treatment of overweight and obesity incorporating one-on-one health professional-patient relationships, are excluded. Interventions for preventing drug and alcohol use are also excluded.

The target group for the purpose of the review is adolescents aged 13 to18 years; however evidence from broader age groups containing this target group are also included. Outcomes of interest include change in knowledge, change in mediators, change in behaviours, and/or change in physical status.

2. Methods

2.1. Search strategy

Systematic literature searches were performed in January 2010 using the following twelve electronic databases:

1. MEDLINE
2. EMBASE
3. PsycINFO
4. Web of Science
5. Scopus
6. ERIC
7. All EBM reviews (Cochrane DSR, ACP Journal Club, DARE, CCTR, CLEED, CLCMR and CLHTA)
8. A+ Education
9. APA-FT: Australian Public Affairs Full Text
10. LLBA: Linguistics and Language Behaviour Abstracts
11. Proquest Education journals and CBCA Education
12. SPORTDiscus.

No starting time limit was employed for search criteria as interventions involving interactive electronic media were expected to be recent. Databases were searched for literature from the earliest publication date until December 2009. Numerous search terms were employed to denote interactive electronic media interventions (e.g. communications media, internet, electronic mail, multimedia, electronic media, web, online, email, social networking, social networking media, computer mediated communications), prevention (e.g. prevention, prevention study, intervention, intervention studies, primary prevention, health promotion), overweight and obesity (e.g. obesity, overweight, body weight, weight), adolescents (e.g. adolescent, child, children, pediatric, paediatric, teen, youth), and smoking (e.g. smoke, smoking, tobacco smoking). Full search strategies are provided in Appendix 1.

In addition, a number of websites were searched for grey literature including government and agency reports:

1. Australian Government Department of Health and Ageing http://www.health.gov.au/
2. Australian Government National Health and Medical Research Council (NHMRC) http://nhmrc.gov.au/
3. Scottish Intercollegiate Guidelines Network (SIGN) http://www.sign.ac.uk/
4. US Centers for Disease Control and Prevention (CDC) http://www.cdc.gov/
5. McMaster University (Canada) http://www.mcmaster.ca/
6. National Health Service (NHS) Choices (United Kingdom) http://www.nhs.uk/
7. US Department of Health & Human Services, National Institutes of Health (NIH) http://www.nih.gov/
8. New South Wales Government Department of Education and Training https://www.det.nsw.edu.au.

Details of the full website search strategies are available on request from the authors.

2.2. Selection of relevant publications

The following inclusion and exclusion criteria were applied to research publications identified through the search strategy.

Inclusion criteria

- Publications: peer reviewed literature (including descriptive studies, controlled comparison studies, and systematic reviews) and grey literature (including government reports and agency reports)
- Interventions focused on the prevention of overweight and obesity and smoking prevention
- Interventions targeting adolescents aged 13 to18 years
- Interventions from Australia or other comparable countries
- Studies with outcomes including change in knowledge, change in mediators, change in behaviours and/or change in physical status.

Exclusion criteria

- Interventions that are clinically focused involving treatment of adolescents with established medical conditions resulting from overweight or obesity or focused on the prevention of alcohol and drug abuse
- Interventions targeting adults or children aged less than 13 years
- Interventions from countries which are non-comparable to Australia.

Citation titles and abstracts were screened for relevance to the review using the abovementioned inclusion and exclusion criteria. Studies that were clearly not relevant to the review were excluded. Full text articles of potentially eligible citations were obtained and assessed using the inclusion and exclusion criteria. Ineligible studies were excluded.

In addition, reference lists from obtained articles were reviewed for potentially relevant articles and websites cited in relevant articles viewed.

2.3. Study appraisal

In order to evaluate the quality and strength of evidence, each study was appraised according to specific criteria. A quality assessment checklist was developed based on the *Data Extraction Template for Cochrane Reviews*[7] and the *Cochrane Consumers and Communication Review Group Study Quality Guide*[8] to analyse the quality of RCTs and non-RCTs. The checklist addressed questions relating to nine domains: true randomisation (for RCTs only), allocation concealment, blinding, baseline comparability, follow-up, accurate reporting of outcomes, intention to treat analysis, validation of tools and separation of the e-intervention effects from other intervention components.

The following nine questions from the *Critical Appraisal Skills Programme (CASP) appraisal tool*[9] were used to assess systematic reviews:

1. Did the review ask a clearly focused question?
2. Did the review include the right type of study?
3. Did the reviewers try to identify all relevant studies?
4. Did the reviewers assess the quality of the included studies?
5. If the results of the studies have been combined, was it reasonable to do so?
6. Were the results presented adequately and their meaning derived appropriately?
7. How precise are these results?
8. Can the results be applied to the local population?
9. Were all important outcomes considered?

Other intervention studies such as before and after descriptive studies were assessed using the following nine questions adapted from the *Appraisal Checklist* tool[10]:

1. Did the study address a clearly focused issue?
2. Were the inclusion/exclusion criteria given?
3. Was the choice of control group (if included) adequate?
4. Were tables/graphs adequately labelled and understandable?
5. Were you confident with the authors' choice and use of statistical methods, if employed?
6. Were the authors' conclusions adequately supported by the information cited?
7. Can the results be applied to the local situation?
8. Were all important outcomes/results considered?
9. Did the study separate the effects of the electronic intervention from other intervention components?

3. Summary of intervention evidence

The literature search for adolescent overweight and obesity interventions recovered 1,352 citations of which 1,337 were not considered to be relevant to the review. A number of interventions were excluded on the basis that they were too intense for the scope of this review (i.e. treatment interventions involving a one-on-one health professional-patient relationship)[11-16]. Fifteen intervention studies and reviews (including eating disorder related interventions) were identified that were relevant to the scope of the review.

The literature search for adolescent smoking interventions recovered 766 citations of which 759 were not considered to be relevant to the review. Seven intervention studies and reviews were identified that were relevant to the scope of the review.

A summary and brief appraisal of the evidence level and quality of each intervention is provided below. A summary table of the interventions is provided in Appendix 2. Interventions are categorised as follows:

- Adolescent overweight and obesity interventions
- Adolescent eating disorder interventions
- Adolescent smoking interventions.

3.1. Adolescent overweight and obesity interventions

3.1.1. Reviews relating to adolescent overweight and obesity interventions

3.1.1.1. Review of web-based weight management programs for children and adolescents[17]

A 2009 systematic review of RCTs was conducted to provide the scientific evidence regarding the effectiveness of web-based weight management programs for children and adolescents. All studies were based on US interventions that were participant or family oriented and delivered in a variety of settings. Seven RCTs included adolescents in the participant sample and relevant RCTs are discussed in further detail below[15,18-19]. Most (75%) studies reported that internet interventions showed clinically and statistically significant changes in measurable outcomes such as BMI, weight loss, physical activity and dietary fat intake. The authors conclude that web-based interventions show potential for weight management in overweight children and adolescents and recommend that further research is undertaken to optimise the internet as an effective delivery mode for children and adolescents.

Study appraisal

This systematic review included seven US RCTs with adolescents, five of which were based on African American or ethnically diverse populations. Although findings from this quality review suggested a potential for web-based behavioural interventions for weight management in overweight children and adolescents, their application to an Australian setting is unclear and further research is needed in this area.

3.1.1.2. Review of technological advances in modifying adolescent health risk behaviours[20]

A recent systematic review examined evidence from RCTs of technological interventions for various adolescent health behaviours, including obesity and physical inactivity. Of the nine RCTs addressing obesity and physical inactivity, three RCTs met our search criteria and are discussed in further detail below[15,19,21]. Positive outcomes such as reduction in BMI, weight, body fat and increase in physical activity were reported in these three RCTs. Although further research is needed, the authors conclude that technological interventions can play an important role in improving adolescent health behaviours, even as adjuncts to traditional methods.

Study appraisal
This systematic review highlighted the potential of technological interventions in improving adolescent health behaviours. However, the literature search was limited to two bibliographic databases and the review identified only three RCTs that corresponded to our search criteria[15,19,21]. Evidence from these RCTs are summarised and appraised below.

3.1.2. Delivery method of nutrition and physical activity information and behaviour change in adolescents[21]

In a US non-randomised controlled study based in Florida, students (N=311; mean age: 15.8 years) were assigned to one of three interventions. The study was conducted in three schools: one served as the control, one received traditional education and one received computer-based education. The 16-week intervention comprised five educational sessions lasting 45 minutes each. The computer intervention involved education via a CD-ROM, while the traditional intervention group received education via lectures and pamphlets. BMI, nutrition knowledge, physical activity, dietary habits, self efficacy and social support were assessed in the first three and last three weeks of the intervention. Students who received the computer intervention demonstrated increased knowledge, physical activity, self efficacy, and social support, and decreased meals skipped. The authors suggested that future programs may be enhanced by including group discussion and individual feedback with a group facilitator.

Study appraisal
This non-randomised controlled study was based on a convenience sample of predominantly Black (52%) or Hispanic (24%) American students and groups were different in their baseline demographics, including age. The evidence from this study for the effectiveness of a CD-ROM intervention on positive behaviour changes in adolescents should be viewed with caution and may not apply to an Australian setting.

3.1.3. Internet/video nutrition interventions in adolescents[22-23]

In a quasi-experimental non-randomised trial[22], seventh and eighth grade students (N=341; aged 12 to 15 years) from two US schools were either assigned to a control

(school curriculum) or intervention condition delivered over an academic year. Recruitment to either condition was based on classroom assignment. The intervention comprised four internet/video sessions, a healthy snack session and gym class (one school only); each session lasted 50 minutes. Dietary fat and time spent on physical activity were evaluated before and after the intervention. Dietary fat decreased with each internet session in which students participated and the percentage of fat in food decreased significantly in black, white, and black/native girls in the intervention group. Participants who also received the gym session increased time spent on moderate/vigorous physical activity. The study concluded that the internet/video based intervention reduced the percentage of dietary fat intake among female students and that additional internet sessions may be beneficial.

In another quasi-experimental non-randomised trial[23] performed by the same group of investigators, the effectiveness of an eight-session transtheoretical model internet/video intervention (including computer-tailored feedback and individualised emails) on physical activity and dietary fat intake was examined among seventh grade students (n=178) from one US school. Participants who attended more than half of the exercise/nutrition sessions increased their physical activity by an average of 22 minutes and reduced their dietary fat intake by 0.08%.

Study appraisal

These two poorly designed, quasi-experimental US studies can largely be discounted from the evidence base. The analyses were restricted to completers only, it is unclear whether completers were comparable to non-completers, and the studies failed to separate the effects of the internet/video-based sessions from other intervention components (e.g. gym lab, individualised emails, computer-generated feedback). In addition, the study samples were predominantly African American students from a low income background, making it more difficult to generalise findings.

3.1.4. Physical activity and healthy food intervention in adolescents[18, 24]

A Belgian cluster RCT of 15 schools (mean age of students: 13.1±0.8 years) examined the effectiveness of a two year middle school physical activity and healthy eating intervention, including an environmental and computer-tailored component. Schools were randomly assigned to one of 3 conditions: a control group, an intervention only group, or an intervention and parent support group. The intervention involved the promotion of healthy eating and physical activity through the school and student use of a computer-tailored program. Parents received healthy eating and physical activity information three times per year through school newsletters and a CD-ROM with an adult computer-tailored intervention to complete at home. BMI, BMI z-score, physical activity levels and dietary intake of fat, fruit and soft drinks were assessed at baseline, one year and two years. After two years, BMI (difference=0.22) and BMI z-score (difference=0.07) changed in a more positive direction in females receiving the intervention with parental support compared with the other two conditions, while no significant positive intervention effects were seen in males. At one and two years, physical activity levels significantly increased in both genders while dietary fat intake significantly decreased in females.

Study appraisal

This two-year Belgian cluster RCT with a large sample size of 2840 students found that the intervention involving parental support was effective in changing BMI and BMI z-score in a more positive direction in females only. The intervention was also effective in improving physical activity levels in both genders and decreasing fat intake in females only. Randomisation details were not provided and intention to treat analysis was not performed. Furthermore, the study was not able to separate the effects of the environmental and electronic intervention components.

3.1.5. Physical activity intervention in Boy Scouts[25]

A US cluster RCT of 42 troops of Houston Boy Scouts (N=473) aged 10 to 14 years assessed immediate and six-month effects of a physical activity intervention using limited troop time and an internet program. The nine-week intervention involved 20 minutes of weekly skill building activities at troop meetings and twice-weekly internet-based role modelling, review and problem solving. The website also featured weekly physical activity knowledge games and animated role-modelling comics. Demographic, anthropometric and physical activity outcomes were assessed at baseline, after nine weeks and six months. Spring participants showed a 12-minute increase in light intensity physical activity and a trend towards a 12-minute decrease in sedentary behaviour. However, no significant change was observed among fall intervention participants or on the amount of moderate to vigorous physical activity.

Study appraisal

This US cluster RCT based on a large sample showed positive results indicating an increase in physical activity and a trend toward a decrease in sedentary behaviour in the spring intervention group. However, this study was limited to boy scouts and contributes little to the evidence base as the study was not able to separate the effects of the troop and internet intervention components.

3.1.6. Internet-facilitated intervention for reducing binge eating and overweight in adolescents[26]

A US RCT of 105 high school students (mean age: 15.1±1.0 years) at risk of overweight (≥85th percentile for age-adjusted BMI) examined the efficacy of an internet-facilitated intervention for weight maintenance and binge eating in adolescents. Students (64% Caucasian) were randomly assigned to a 16-week internet intervention or waitlist control group that would receive the intervention after the study. The psychoeducational and behavioural internet intervention included self-monitoring, goal setting, stimulus control, appetite awareness, emotion regulation skills along with interactive activities and an asynchronous discussion group facilitated by a research assistant. BMI, BMI z-score and binge eating behaviour (assessed by a semi-structured diagnostic interview) were examined at baseline, post intervention, and nine months. Anthropometric data were self-reported at 16 weeks and were not included in the analyses. Significant reductions in BMI and BMI z-score were observed in the intervention group (mean BMI z-score change: -1.2) as compared with the control group (mean BMI z-score change: 0.03) at the nine-month follow-up. Significant reductions in objective and subjective binge episodes and weight and shape concerns were also found in the intervention group. The study concludes that weight

management and a reduction in eating disorder features can be simultaneously achieved through an internet-facilitated program.

Study appraisal

This high quality US RCT provides evidence that a 16-week internet-facilitated program can simultaneously result in weight reduction alongside reductions in objective and subjective binge episodes and weight and shape concerns in adolescents.

3.1.7. Internet intervention to promote self efficacy for healthy eating in adolescents[27]

In a US quasi-experimental study, 121 students (mean age: 13 years) in two schools were assigned to receive either the intervention; a combination of five hours of web-based interactive nutrition education and 10 hours of classroom curriculum; or the control, nutrition education embedded in the standard school curriculum. Self efficacy for healthy eating, dietary knowledge, food choices, and food intake were evaluated via questionnaires at baseline and after the one month intervention. The intervention group had higher self efficacy for healthy eating, greater dietary knowledge and healthier usual food choices compared with the control group. Food consumption did not differ between the groups.

Study appraisal

This US quasi-experimental study based on an ethnically diverse sample can largely be discounted from the evidence base as it is unclear whether the groups were comparable at baseline, intervention assignment was not randomised and the study failed to separate the effects of the web-based intervention component from the classroom component.

3.1.8. Internet intervention for the prevention of eating disorders and weight gain in female adolescents[28]

A US study investigated the feasibility of using an online screening program to assess the risk of developing an eating disorder or obesity among sophomore female students (N=174) attending a Californian private high school. The online program provided individualised feedback to students about their level of risk and students were invited to participate in one of four interventions appropriate to their risk (universal core health curriculum, targeted body image (BI) enhancement curriculum, targeted weight management (WM) curriculum, combined BI and WM curriculum). All interventions included the core program and incorporated online discussions about related topics. The intervention duration was not mentioned and only the core and BI interventions were delivered. Over half of participants identified as being at risk of overweight or developing an eating disorder by the online program chose to receive the recommended targeted curricula. All participants (including those that rejected the targeted curricula) showed significant improvements in weight and shape concerns.

Study appraisal

This US study showed that using an internet delivered program to assess eating disorder and obesity risk and provide individualised feedback was feasible among Californian female students. Unfortunately, the study was based on a small sample of female students in one school, lacked detailed information about study design and interventions, and did not evaluate the separate effects of the core and targeted curricula or online components of each curricula.

3.1.9. Comparison of web and print media for physical activity promotion in female adolescents[19]

A two week RCT in 319 females (mean age: 12.1 years) from four US middle schools compared the effectiveness of web versus print media for physical activity promotion in a two week intervention. While both interventions resulted in significant changes in physical activity self efficacy and intentions, the print group demonstrated significantly greater increases in physical activity intentions compared with the web group. Self-reported physical activity also increased significantly in the print group only. The study concludes that while adolescents report a greater preference for interactive electronic media, traditional print versions may provide a more effective environment for learning and persuasion.

Study appraisal
Although based on an ethnically diverse population (50% black, 38% Caucasian, 12% other) and a somewhat crude method of randomisation (coin toss), this short-term US RCT contributes to the evidence base with results indicating that despite adolescent preferences for electronic interventions, traditional print versions may provide a more effective environment for increasing physical activity intentions and self-reported behaviour.

3.1.10. Internet-based health behaviour program to promote healthy eating and physical activity in female adolescents[29-30]

A US preliminary study[29] investigated the feasibility and efficacy of an internet-based health behaviour program promoting healthy eating among 41 female students from a rural, medically underserved high school. The 6-week intervention was designed as an online teen magazine and consisted of 6 weekly modules addressing healthy eating and consumption of specific foods. The comparison group received the standard health curriculum. The consumption of regular meals, fruit and vegetables, breads and cereals, high fat snacks, high fat dairy and soda drinks were assessed before and after the intervention. The study showed that the internet-based *Eat4Life* health behaviour program had positive effects on consumption of all target foods except for soda drinks.

In a non-RCT[30] performed by the same group of researchers, the efficacy of the internet-based *Eat4Life* program including new nutrition and physical activity content was examined among 180 female students from the same school. Female students from grades 9 and 10 were either assigned to receive the standard health curriculum or five-weekly internet module intervention promoting healthy eating and physical activity. In addition to previous outcomes, the consumption of fast food and engagement in physical activity were assessed at baseline and 5 weeks. The internet-

based intervention was effective in promoting positive changes in the consumption of regular meals, fruit and vegetables, breads and cereals, fibre, soda drinks, fast food and physical activity.

Study Appraisal
Evidence from these two poorly designed US studies should be viewed with caution as they are based on a single rural high school with female students presumably from a low socioeconomic background (although details about baseline group demographics were not presented).

3.3. Adolescent eating disorder interventions

3.3.1. Internet-delivered eating disorder prevention program for adolescents and their parents[31]

A US non-RCT in 153 adolescent girls (mean age: 15.1 years; 56% Caucasian) and 69 of their parents evaluated the effectiveness of *Student Bodies*, an eight-week program of one hour psychoeducational internet sessions. The efficacy of an educational internet program provided to parents was also examined. Outcomes were evaluated at baseline, two months and 18 months (adolescents only). Significantly decreased eating restraint was reported and greater increases in knowledge were observed in intervention students compared with controls, while intervention parents significantly decreased their critical weight and shape attitudes.

Study appraisal
It is unclear whether this US non-RCT based on adolescent girls informs the evidence base as certain aspects are not adequately described making assessment of study quality difficult. Type of analysis and follow up details are not provided, additionally, group allocation was not adequately concealed and blinding inadequate.

3.3.2 Internet-delivered intervention for body dissatisfaction and disordered eating in adolescent girls[32]

An Australian RCT aimed to evaluate the outcomes of an online body image and disordered eating program compared to a delayed treatment control in 83 adolescent girls from Victoria and NSW (mean age: 14.4 years; self-identified as having body image or eating problems; predominantly Caucasian). The six-week intervention consisted of six, 90-minute weekly group (four to eight participants) online sessions facilitated by a therapist and manual. Measures of body dissatisfaction, disordered eating and psychological functioning were assessed at baseline, six to eight weeks, two months and six months. Clinically significant improvements in body dissatisfaction, disordered eating and depression were found post-intervention and maintained at six month follow up. Participants regarded the internet as an appropriate mode of program delivery.

Study appraisal

This high quality Australian RCT contributes to the eating disorder intervention evidence base with the six-week program offering a promising approach to improve body image and disordered eating in female adolescents. Furthermore this trial was conducted in a range of girls from metropolitan and regional/remote areas of Australia (including NSW).

3.4 Adolescent smoking interventions

3.4.1 Review of computer and internet-based interventions for smoking behaviour[33]

A 2006 systematic review identified studies published between 1995 and 2004 that incorporated computer or internet-based interventions for smoking prevention or cessation. Out of the four studies performed in adolescents, two computer-based studies met our selection criteria. One smoking prevention and cessation intervention[34] assigned 36 vocational Dutch schools with students aged 12 to 16 years to one of four conditions: 1) control; 2) three in-school education sessions; 3) three computer-tailored letters mailed to students' homes following completion of an in-school questionnaire; or 4) both in-school and computer-based interventions. Compared to the control group, a significant reduction in smoking initiation was reported in the group receiving computer-tailored feedback letters at 18 months. The impact of receiving the school program only was not assessed at 18 months while the combined intervention showed no additional benefit at follow up. In contrast, the other study[35] reported no significant benefit on smoking initiation at one- and two-year follow-up among 13 to 14 year old British students from 26 schools receiving both classroom and interactive computer smoking prevention sessions relative to controls. Both of these studies are further described below.[34-35]

Study appraisal

This systematic review of studies published between 1995 and 2004 was not exhaustive as it was based on three bibliographic databases and English language studies only. It identified only two adolescent studies pertinent to this review which differed in treatment delivery and provided conflicting results. Hence, this systematic review does not provide convincing evidence for the effectiveness of computer interventions on smoking initiation among adolescents.

3.4.2 School program and computer-tailored out-of-school program to prevent smoking initiation[34]

A Dutch cluster RCT of 36 vocational schools (2376 students, mean age 13.1 years, males: 52.1%) examined the effects of an existing in-school program and a computer-tailored out-of-school program to prevent smoking initiation. The in-school intervention consisted of three lessons lasting 50 minutes and provided education on the ingredients of tobacco, the effects of smoking on the body, the social influences of smoking and cigarette refusal skills. The out-of-school intervention comprised three computer-tailored letters with smoking prevention messages which were mailed to students' homes at three-week intervals. Feedback in each letter was based on

results from a pre-test questionnaire assessing attitudes, social norms, self efficacy, smoking intention and smoking behaviour. Outcomes were assessed every six months up until 18 months. The computer-tailored out-of-school intervention was found to be effective at reducing smoking initiation at 18 months compared to the control condition.

Study appraisal

This Dutch cluster RCT provides some evidence that an out-of-school intervention consisting of computer-tailored feedback letters mailed to students' homes can have an impact on smoking initiation at 18 months. However, the evidence should be viewed with caution as there were demographic differences observed among groups at baseline and a lack of information about randomisation, allocation concealment and blinding. In addition, no evidence for effectiveness of the out-of-school program was found prior to 18 months. It is unclear whether the effects observed are due to students' receiving feedback only and how the mode of feedback delivery would impact their smoking intention and behaviour.

3.4.3 School program featuring classroom and interactive computer sessions to prevent smoking initiation[35-36]

A British cluster RCT of 52 schools with students aged 13 to 14 years (50% females; 86% Caucasian) examined the effects of combined classroom and interactive computer sessions delivered over three school terms on smoking status and state of change. The three classroom lessons lasted one hour each and provided education on state of change, pros and cons of smoking and decisional balance. The three interactive computer sessions consisted of video clips of young people discussing their smoking along with questionnaires assessing students' state of change and other components of the transtheoretical model. Participants were given feedback by the computer program on their progress at each session. Questionnaires assessing smoking status and potential confounders were also completed at baseline, one year and two years. The classroom and interactive computer program was ineffective at reducing smoking initiation at either one or two years.

Study appraisal

This is a high quality British cluster RCT with a large sample size and a long follow-up period (up to two years). The study found no convincing evidence for effectiveness of a combined classroom and interactive computer program on smoking initiation among 13 to 14 year old students, even when taking into account the number of computer sessions attended. Unfortunately, the separate effects of the classroom and computer-based components were not investigated.

3.4.4 An internet-based school program for smoking prevention[37]

A pair matched RCT of 25 Australian (grades 7 to 9) and 21 American (grades 6 and 7) schools examined the impact of an internet-based school program for smoking prevention. Students in the Australian trial were mostly 13 to 16 years of age, while those in the American trial were mainly under 13 years. The intervention consisted of six 45-60-minute computer lab sessions and allowed students to progress through six modules following completion of each module: introduction, media literacy,

relationships, mind and body, decision making and resistance strategies. Outcomes of the Australian and American trials were assessed separately. The 30-day smoking prevalence (number of days in the previous month that a whole cigarette was smoked), future smoking susceptibility, potential moderators and mediators of program effects were assessed at baseline and following the intervention. The internet-based smoking prevention school program significantly decreased 30-day smoking prevalence in the Australian trial only, whereas there was a decreased likelihood of participants smoking in the future in the American trial.

Study appraisal

This pair matched RCT with a large sample size (46 schools, 2514 predominantly Caucasian students) showed that an internet-based school program was effective in decreasing 30-day smoking prevalence among Australian students from Victoria and South Australia (mostly 13 years or older) but not among younger American students. The reasons for different outcomes in the two trials are unclear but could be due to a number of reasons including an age difference between both trials and partial program exposure. Further investigation is warranted.

3.4.5 An internet-assisted school program for smoking prevention and cessation[38-39]

A Canadian RCT involving 1402 students (54% males) from grades 9 to 11 from 14 different schools evaluated the effects of an internet-assisted school smoking prevention and cessation program. The internet-assisted program consisted of a single one hour session including a five stage interactive website with quizzes and self assessments; recording of scores in a paper journal; a small group motivational interview; and tailored, follow-up emails sent on a monthly basis for a period of six months. To enable similar engagement levels in the control group, participants in the latter attended a single one hour session featuring an evaluation of climate change websites using a tool developed by the investigators; recording of scores in a paper journal; a small group discussion; and generic follow-up monthly emails about evaluation strategies for online materials. Resistance to smoking, behavioural intentions to smoke, and cigarette use were assessed at baseline, post intervention, three months and six months. The school internet-assisted intervention had a significant effect on preventing heavy smoking in non-smoking adolescents at six months.

Study appraisal

This Canadian RCT with a large sample size and moderate follow up period showed that an internet-based school program was effective at preventing heavy smoking in non-smoking adolescents at six months. Unfortunately, the separate effects of the computer, group discussion and email components of the intervention were not evaluated.

3.4.6 ASPIRE (Impact of A Smoking Prevention Interactive Experience): an interactive, computer-based school program for smoking prevention and cessation[40]

A US nested cohort group RCT of 16 high schools evaluated the impact of ASPIRE, an interactive computer-based smoking prevention and cessation program among culturally diverse tenth grade students. The CD-ROM-based educational program was delivered during five-weekly, 30-minute sessions in one semester and two booster sessions in the following semester. Smoking status was assessed along with decisional balance, temptations to smoke, self efficacy, aids to smoking resistance, peer and parental smoking at baseline; whereas smoking initiation rates and smoking behaviour (primary outcomes) were examined at 18 months. Participants receiving ASPIRE demonstrated significant positive decisional balance against smoking and decreased temptations to smoke. The interactive, computer-based program was effective in reducing smoking initiation among culturally diverse students at 18 months.

Study appraisal

This US RCT with an adequate sample size and a long follow-up period (18 months) provides evidence for the effectiveness of an interactive CD-ROM program in preventing smoking among culturally diverse (mainly Hispanic) students. However, the evidence should be viewed with caution as groups differed in baseline characteristics and analysis was based on completers only.

3.4.7 Smarter than Smoking project: a multi-approach program including an interactive website for smoking prevention and cessation[41]

An intervention study examined the effects of Smarter than Smoking, a Western Australian multi-strategy program, on smoking prevalence among different samples of 10 to 15 year olds over a 10 year period. The program incorporated mass media, school based education, health sponsorship, publications, merchandise, advocacy and a website. The OxyGen youth website featured interactive educational activities along with smoking and tobacco-related information. Smoking prevalence, campaign awareness, attitudes towards smoking and campaign messages were assessed over a 10-year period at five different time points using school based and face to face street intercept surveys of adolescents. The state wide multi-strategy program had a positive impact on decreasing smoking initiation and prevalence among young Western Australians.

Study appraisal

This long-term Western Australian intervention study with a large sample size demonstrated that a state wide multi-strategy approach to smoking prevention could be effective in decreasing smoking initiation among adolescents. Unfortunately, the individual effects of this multi-strategy program were not evaluated. Therefore, this study does not contribute to the evidence base regarding the effectiveness of an interactive website on smoking prevention.

4. Intervention evidence appraisal and relevance to NSW

There is very limited literature relating to interactive electronic media interventions for adolescent obesity prevention and, in fact, even fewer studies relating to smoking prevention. Despite this, the limited available research evidence provides some insight to assist in informing future directions and options for designing and implementing health promotion programs for preventing overweight and obesity in adolescents.

The two systematic reviews[17,20] relating to obesity prevention highlight the potential for electronic interventions in improving health behaviours related to weight status but recommend that further research is required. Eleven of the twelve adolescent overweight and obesity prevention/treatment studies demonstrate positive outcomes in participants receiving interventions incorporating electronic media including increased knowledge, changes in attitudes (e.g. increased self efficacy and reduction in weight and shape concerns), positive behaviour changes (e.g. increased physical activity, decreased skipped meals, decreased dietary fat intake, reduction in objective and subjective binge episodes, and healthier usual food choices) and reductions in BMI and BMI z-score. However, of these studies only one was deemed high quality. This US RCT[26] provides convincing evidence that a 16-week psychoeducational and behavioural internet intervention (*StudentBodies2-BED*) incorporating self-monitoring, goal setting, stimulus control, appetite awareness, emotion regulation skills, interactive activities, and an asynchronous discussion group can simultaneously result in weight reduction alongside reductions in objective and subjective binge episodes and weight and shape concerns. While electronic interventions appear a promising approach for the prevention of overweight and obesity in adolescents, based on the available evidence, further research is required.

Of the two reviewed adolescent eating disorder interventions, one was deemed high quality. The Australian RCT[32] showed that a six-week intervention consisting of six, 90-minute weekly group online sessions facilitated by a therapist resulted in clinically significant improvements in body dissatisfaction, disordered eating and depression post-intervention and maintained at six months follow up. Furthermore, this trial was conducted in both metropolitan and regional Australia.

The systematic review of smoking prevention studies[33] does not provide convincing evidence for the effectiveness of electronic interventions on adolescent smoking initiation. Five of the six smoking interventions demonstrate positive outcomes including reductions in smoking initiation and prevalence. However, of these only one study was deemed high quality. This British RCT[35-36] of 52 schools found no convincing evidence for the effectiveness of a combined classroom and interactive computer intervention on smoking initiation.

Overall, many interventions incorporated multiple components and, while some showed positive results, most of these studies failed to separate the effects of the electronic intervention components from other intervention components. The individual effects of different electronic components (e.g. individualised emails,

computer tailored feedback) within electronic interventions were also not evaluated. These studies can be largely discounted from the electronic intervention evidence base as the electronic intervention components have not been adequately evaluated.

Research gaps in the existing evidence base include studies in non-school settings, high quality well-designed long-term trials, studies incorporating innovative electronic media such as social networking media and e-whiteboards, studies in Australian populations, and studies targeted towards both adolescents and their parents. The vast majority of studies reviewed were conducted in school settings and thus further investigation of interventions in other settings is required. There is a lack of high quality long-term studies, particularly those relating to the prevention of overweight and obesity. Studies predominantly incorporated interactive internet sites, while social networking media such as Facebook were not investigated despite adolescents' reported high usage of such media. Research indicates that adolescent weight management programs involving parents have better outcomes that programs that do not[2]; however, only two of the review studies target both adolescents and their parents[18,24]. Further investigation of these areas is required.

Research results should be viewed with caution as only three studies were conducted in Australia[32,37,41] and only one of those in NSW[32]; of these, none related to overweight or obesity prevention in adolescents. The vast majority of adolescent obesity prevention studies were conducted in the US, largely in minority populations. The direct transferability of interventions and subsequent findings into the NSW environment is unclear. There is a clear need for further Australian research in this area to accurately inform the evidence base.

5. Recommendations

The following recommendations are based on expert opinion following analysis of the strength and quality of evidence from existing systematic reviews and key research studies relating to interactive electronic media interventions for adolescent overweight/obesity, eating disorder and smoking prevention.

1. Further high quality Australian interventions using electronic media interventions to prevent overweight or obesity in adolescents should be conducted

Due to the paucity of Australian interactive electronic media interventions in adolescents across a range of health domains, it is recommended that further studies are conducted to determine the relevance of such interventions in the Australian context. Future studies should aim for high quality evidence and assess both short-term and long-term outcomes resulting from interactive electronic media interventions.

2. Consider the inclusion of an innovative electronic media intervention component in adolescent overweight and obesity prevention programs

An innovative electronic media intervention component should be considered for inclusion in adolescent overweight and obesity prevention programs. Despite the need for further high quality research, electronic interventions appear a promising approach for the prevention of overweight and obesity in adolescents. Program planners should also take into account adolescents' high reported usage of, and preference for, such media.

3. Develop interventions that specifically target the requirements of adolescents

Such interventions should specifically target adolescents and should appeal to the requirements of this target group which may differ widely from interventions that would appeal to children or adults. Experts in youth communication and professional marketers should be engaged to assist in intervention design, development and dissemination.

The following list details some examples of well designed interactive websites for adolescents:

- Above the Influence - http://www.abovetheinfluence.com/
- Reach Out - http://au.reachout.com/

- Teen Central - http://www.teencentral.net/index.php
- Teenage Health Freak -
- http://www.teenagehealthfreak.org/homepage/index.asp
- National Health Service Teen LifeCheck - http://www.teenlifecheck.co.uk/
- The Truth - http://www.thetruth.com/
- The Smoking Zine - http://smokingzine.org/
- Planned Parenthood - http://www.plannedparenthood.org/teen-talk/
- Sex, etc - http://www.sexetc.org/
- Teens Health - http://kidshealth.org/teen/.

4. Engage adolescents in the development of any planned electronic health promotion interventions

Adolescent preferences should first be investigated and incorporated into any planned electronic media interventions for the prevention of overweight and obesity. Adolescents should be engaged in the development of the intervention in order to ensure the program is relevant, dynamic and fun, thereby increasing the likelihood of intervention effectiveness and participation. For example, it may be appropriate to initially conduct adolescent focus groups and one-on-one interviews by youth communication experts. It is essential that adolescents feel a sense of ownership and engagement in the intervention.

5. Ensure that adolescent safety and wellbeing are paramount considerations in intervention development

The consideration of adolescent safety and wellbeing should be paramount in intervention development. Specifically, all efforts must be made to ensure that obesity prevention interventions are safe for those who are underweight or at risk of the development of eating disorders, and that overweight or obese young people are not subject to stigmatisation.

6. Implement interventions using an appropriate delivery medium in an appropriate setting

The majority of reviewed interventions were conducted via interactive internet programs in schools. The appropriateness of these methods has not been conclusively evaluated. Once again, adolescents need to be engaged via focus groups and one-on-one interviews with youth communication experts to determine the most appropriate delivery medium and setting. While schools provide a useful avenue to access adolescents, our experience, from focus groups conducted with obese adolescents and their parents, indicates that adolescents are reluctant to receive school based weight management interventions due to the fear of stigmatisation.[42] The use of social networking media as intervention delivery medium needs to be investigated due to its popularity among adolescents.

7. Develop and disseminate appropriate obesity prevention messages

Appropriate obesity prevention messages include those related to healthy eating, increasing physical activity, reducing sedentary behaviour (especially screen time), promoting self efficacy, and targeting selected high-risk behaviours. Available research evidence indicates that most interventions are multifaceted i.e. focus on numerous aspects of obesity prevention such as the inclusion of both healthy eating and physical activity messages.

8. Conduct effective intervention evaluation, incorporating specific evaluation of the electronic intervention

Program evaluation should be incorporated into any planned interactive electronic media intervention. Specific evaluation of the electronic intervention component is required. While a multi-component program may be implemented it is important to have the ability to evaluate the intervention effects of each component separately.

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APPENDICES

Appendix 1: Search strategies

Interactive electronic media interventions for preventing overweight and obesity in adolescents

MEDLINE

1. exp Communications Media/
2. exp Internet/
3. exp Electronic Mail/
4. exp Multimedia/
5. ('electronic media' or internet or web or online or 'electronic mail' or email or 'social networking' or 'social networking media').mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]
6. exp Intervention Studies/
7. exp Primary Prevention/
8. exp Health Promotion/
9. (intervention or prevent* or 'health promotion').mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]
10. exp Adolescent/
11. exp Child/
12. exp Pediatrics/
13. (adolesc* or teen* or child or pediatric or paediatric or youth).mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]
14. exp Obesity/
15. exp Overweight/
16. exp Body Weight/
17. (obes* or overweight or weight).mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]
18. 1 or 2 or 3 or 4 or 5
19. 6 or 7 or 8 or 9
20. 10 or 11 or 12 or 13
21. 14 or 15 or 16 or 17
22. 18 and 19 and 20 and 21.

EMBASE

1. exp internet/
2. exp e-mail/
3. exp multimedia/
4. ('electronic media' or internet or web or online or 'electronic mail' or email or 'social networking' or 'social networking media').mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
5. exp prevention study/
6. exp intervention study/

7. exp primary prevention/
8. exp health promotion/
9. (intervention or prevent* or 'health promotion').mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
10. adolescent/
11. child/
12. exp pediatrics/
13. (adolesc* or teen* or child or pediatric or paediatric or youth).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
14. exp obesity/
15. exp body weight/
16. (obes* or overweight or weight).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
17. 1 or 2 or 3 or 4
18. 5 or 6 or 7 or 8 or 9
19. 10 or 11 or 12 or 13
20. 14 or 15 or 16
21. 17 and 18 and 19 and 20.

PsycINFO

1. exp Communications Media/
2. exp Internet/
3. exp Computer Mediated Communication/
4. ('electronic media' or internet or web or online or 'electronic mail' or email or 'social networking' or 'social networking media').mp. [mp=title, abstract, heading word, table of contents, key concepts]
5. exp Prevention/
6. exp Intervention/
7. exp Health Promotion/
8. (intervention or prevent* or 'health promotion').mp. [mp=title, abstract, heading word, table of contents, key concepts]
9. exp pediatrics/
10. (adolesc* or teen* or child or pediatric or paediatric or youth).mp[mp=title, abstract, heading word, table of contents, key concepts]
11. exp Obesity/
12. exp Overweight
13. exp Body Weight/
14. (obes* or overweight or weight).mp. [mp=title, abstract, heading word, table of contents, key concepts]
15. 1 or 2 or 3 or 4
16. 5 or 6 or 7 or 8
17. 9 or 10
18. 11 or 12 or 13 or 14
19. 15 and 16 and 17 and 18.

ERIC

1. exp Internet/
2. exp Electronic Mail/
3. ('electronic media' or internet or web or online or 'electronic mail' or email or 'social networking' or 'social networking media').mp. [mp=abstract, title, headings word, identifiers]
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5. exp Intervention/
6. exp Health Promotion/
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12. exp Obesity/
13. exp Body Weight/
14. (obes* or overweight or weight).mp. [mp=abstract, title, headings word, identifiers]
15. 1 or 2 or 3
16. 4 or 5 or 6 or 7
17. 8 or 9 or 10 or 11
18. 12 or 13 or 14
19. 15 and 16 and 17 and 18.

All EBM Reviews (Cochrane DSR, ACP Journal Club, DARE, CCTR, CLEED, CLCMR and CLHTA)

1. ('communications media' or internet or multimedia or 'electronic media' or web or online or email or 'social networking' or 'social networking media').mp. [mp=ti, ot, tx, hw, kw, ab, sh, ct]
2. (intervention or prevent* or 'health promotion').mp. [mp=ti, ot, tx, hw, kw, ab, sh, ct]
3. (adolesc* or teen* or child or pediatric or paediatric or youth).mp. [mp=ti, ot, tx, hw, kw, ab, sh, ct]
4. (obes* or overweight or weight).mp. [mp=ti, ot, tx, hw, kw, ab, sh, ct]
5. 1 and 2 and 3 and 4.

Web of Science

1. TS=('communications media' or internet or multimedia or 'electronic media' or web or online or email or 'social networking' or 'social networking media')
2. TS=(intervention or prevent* or 'health promotion')
3. TS=(adolesc* or teen* or child or pediatric or paediatric or youth)
4. TS=(obes* or overweight or weight)
5. 1 and 2 and 3 and 4.

Scopus

1. ((**communications media** OR **internet** OR **electronic mail** OR **multimedia** OR **web** OR **online** OR **email** OR **social networking** OR **social networking media**) AND (**intervention** OR **prevent*** OR **health promotion**) AND (**adolesc*** OR **teen*** OR **child** OR **pediatric** OR **paediatric** OR **youth**) AND (**obes*** OR **overweight** OR **weight**)).

A+ Education

1. ('communications media' or internet or multimedia or 'electronic media' or web or online or email or 'social networking' or 'social networking media') AND (intervention or prevent* or 'health promotion') AND (adolesc* or teen* or child or pediatric or paediatric or youth) AND (obes* or overweight or weight).

APA-FT: Australian Public Affairs Full Text

1. ('communications media' or internet or multimedia or 'electronic media' or web or online or email or 'social networking' or 'social networking media') AND (intervention or prevent* or 'health promotion') AND (adolesc* or teen* or child or pediatric or paediatric or youth) AND (obes* or overweight or weight).

LLBA: Linguistics and Language Behaviour Abstracts

1. internet or 'electronic media' or email AND
2. intervention or prevent* or 'health promotion' AND
3. adolesce* or teen* or child AND
4. obes* or overweight or weight.

Proquest Education journals and CBCA Education

1. internet or 'electronic media' or email AND
2. intervention or prevent* or 'health promotion' AND
3. adolesce* or teen* or child AND
4. obes* or overweight or weight.
5.

SPORTDiscus

1. ('communications media' or internet or multimedia or 'electronic media' or web or online or email or 'social networking' or 'social networking media') AND (intervention or prevent* or 'health promotion') AND (adolesc* or teen* or child or pediatric or paediatric or youth) AND (obes* or overweight or weight).

Interactive electronic media interventions for smoking prevention in adolescents

MEDLINE

1. exp Communications Media/
2. exp Internet/
3. exp Electronic Mail/
4. exp Multimedia/('electronic media' or internet or web or online or 'electronic mail' or email or 'social networking' or 'social networking media').mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]
5. exp Intervention Studies/
6. exp Primary Prevention/
7. exp Health Promotion/
8. (intervention or prevent* or 'health promotion').mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]
9. exp Adolescent/
10. exp Child/
11. exp Pediatrics/
12. (adolesc* or teen* or child or pediatric or paediatric or youth).mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]
13. exp Smoking/
14. exp Smoke/
15. (smoke or smoking).mp. [mp=title, original title, abstract, name of substance word, subject heading word, unique identifier]
16. 1 or 2 or 3 or 4 or 5
17. 6 or 7 or 8 or 9
18. 10 or 11 or 12 or 13
19. 14 or 15 or 16
20. 17 and 18 and 19 and 20.

EMBASE:

1. exp internet/
2. exp e-mail/
3. exp multimedia/
4. ('electronic media' or internet or web or online or 'electronic mail' or email or 'social networking' or 'social networking media').mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
5. exp prevention study/
6. exp intervention study/
7. exp primary prevention/
8. exp health promotion/
9. (intervention or prevent* or 'health promotion').mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
10. adolescent/

11. child/
12. exp pediatrics/
13. (adolesc* or teen* or child or pediatric or paediatric or youth).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
14. exp smoking/exp smoke/
15. (smoke or smoking).mp. [mp=title, abstract, subject headings, heading word, drug trade name, original title, device manufacturer, drug manufacturer name]
16. 1 or 2 or 3 or 4
17. 5 or 6 or 7 or 8 or 9
18. 10 or 11 or 12 or 13
19. 14 or 15 or 16
20. 17 and 18 and 19 and 20.

PsycINFO

1. exp Communications Media/
2. exp Internet/
3. exp Computer Mediated Communication/
4. ('electronic media' or internet or web or online or 'electronic mail' or email or 'social networking' or 'social networking media').mp. [mp=title, abstract, heading word, table of contents, key concepts]
5. exp Prevention/
6. exp Intervention/
7. exp Health Promotion/
8. (intervention or prevent* or 'health promotion').mp. [mp=title, abstract, heading word, table of contents, key concepts]
9. exp pediatrics/
10. (adolesc* or teen* or child or pediatric or paediatric or youth).mp[mp=title, abstract, heading word, table of contents, key concepts]
11. exp Tobacco Smoking/
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15. 5 or 6 or 7 or 8
16. 9 or 10
17. 11 or 12 or 13
18. 14 and 15 and 16 and 17.

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1. exp Internet/
2. exp Electronic Mail/
3. ('electronic media' or internet or web or online or 'electronic mail' or email or 'social networking' or 'social networking media').mp. [mp=abstract, title, headings word, identifiers]
4. exp Prevention/

5. exp Intervention/
6. exp Health Promotion/
7. (intervention or prevent* or 'health promotion').mp. [mp=abstract, title, headings word, identifiers]
8. exp Adolescents/exp Children/
9. exp Pediatrics/
10. (adolesc* or teen* or child or pediatric or paediatric or youth).mp[mp=abstract, title, headings word, identifiers]
11. exp Smoking/
12. Smoke.mp.
13. (smoke or smoking).mp. [mp=abstract, title, headings word, identifiers]
14. 1 or 2 or 3
15. 4 or 5 or 6 or 7
16. 8 or 9 or 10 or 11
17. 12 or 13 or 14
18. 15 and 16 and 17 and 18.

All EBM Reviews (Cochrane DSR, ACP Journal Club, DARE, CCTR, CLEED, CLCMR and CLHTA)

1. ('communications media' or internet or multimedia or 'electronic media' or web or online or email or 'social networking' or 'social networking media').mp. [mp=ti, ot, tx, hw, kw, ab, sh, ct]
2. (intervention or prevent* or 'health promotion').mp. [mp=ti, ot, tx, hw, kw, ab, sh, ct]
3. (adolesc* or teen* or child or pediatric or paediatric or youth).mp. [mp=ti, ot, tx, hw, kw, ab, sh, ct]
4. (smoke or smoking).mp. [mp=ti, ot, tx, hw, kw, ab, sh, ct]
5. 1 and 2 and 3 and 4.

Web of Science

1. TS=('communications media' or internet or multimedia or 'electronic media' or web or online or email or 'social networking' or 'social networking media')
2. TS=(intervention or prevent* or 'health promotion')
3. TS=(adolesc* or teen* or child or pediatric or paediatric or youth)
4. TS=(smoke or smoking)
5. 1 and 2 and 3 and 4.

Scopus

1. ((**communications media** OR **internet** OR **electronic mail** OR **multimedia** OR **web** OR **online** OR **email** OR **social networking** OR **social networking media**) AND (**intervention** OR **prevent*** OR **health promotion**) AND (**adolesc*** OR **teen*** OR **child** OR **pediatric** OR **paediatric** OR **youth**) AND (**smoking** OR **smoke**)).

A+ Education

1. ('communications media' or internet or multimedia or 'electronic media' or web or online or email or 'social networking' or 'social networking media') AND (intervention or prevent* or 'health promotion') AND (adolesc* or teen* or child or pediatric or paediatric or youth) AND (smoking or smoke)**APA-FT: Australian Public Affairs Full Text**

1. ('communications media' or internet or multimedia or 'electronic media' or web or online or email or 'social networking' or 'social networking media') AND (intervention or prevent* or 'health promotion') AND (adolesc* or teen* or child or pediatric or paediatric or youth) AND (smoking or smoke).

LLBA: Linguistics and Language Behaviour Abstracts

1. internet or 'electronic media' or email AND
2. intervention or prevent* or 'health promotion' AND
3. adolesce* or teen* or child AND
4. smoking or smoke.

Proquest Education journals and CBCA Education

1. internet or 'electronic media' or email AND
2. intervention or prevent* or 'health promotion' AND
3. adolesce* or teen* or child AND
4. smoking or smoke.

SPORTDiscus

1. ('communications media' or internet or multimedia or 'electronic media' or web or online or email or 'social networking' or 'social networking media') AND (intervention or prevent* or 'health promotion') AND (adolesc* or teen* or child or pediatric or paediatric or youth) AND (smoking or smoke).

Appendix 2: Tabulation of available interventions

Table 1. Summary of adolescent overweight and obesity interventions

Study	Design	Participants	Intervention description	Key findings
Casazza et al.[21]	Design: Non-RCT Setting: School Location: Florida, US Duration: 16 weeks	N=311 students from three selected schools 13-18 years (mean age: 15.8 years); 66% females; 52% non-Hispanic black.	Aim: determine which health education delivery method would elicit a greater behaviour change Study in three schools: one served as the control, one received traditional education and one received computer-based education Computer intervention: computer-based education via a CD-ROM; five 45-minute sessions Traditional intervention: education via lectures and pamphlets five 45-minute sessions Outcomes at baseline and 16 weeks: BMI, dietary habits, physical activity, knowledge, self efficacy for diet and physical activity, social support.	Students who received the computer-based intervention demonstrated increased knowledge, physical activity, self efficacy, and social support, and decreased meals skipped.
Frenn et al.[22]	Design: Quasi-experimental non-RCT Setting: School Location: Wisconsin, US Duration: One academic year	N=341 students from two schools; 130 completers 12-15 years; ethnically diverse population; 55% females.	Aim: examine improvement related to Healthy People 2010 Objectives for low fat diet and moderate/vigorous physical activity Students were assigned to the intervention or control group based on classroom assignment Intervention: four internet/video sessions with online feedback, a healthy snack session and a gym class (one school only); each session lasted 50 minute Outcomes: moderate and vigorous physical activity duration, dietary fat intake.	Dietary fat decreased with each internet session in which students participated Percentage of fat in food reduced significantly in black, white and black/native girls in the intervention group Participants receiving the gym lab increased moderate/vigorous physical activity.

Study	Design	Participants	Intervention description	Key findings
Frenn et al.[23]	Design: Quasi-experimental non-RCT Setting: School Location: Wisconsin, US Duration: One month	N=178 students from one school; 103 completers 12-14 years; ethnically diverse population; males and females.	Aim: examine the effectiveness of a health promotion/transtheoretical model internet/video-delivered intervention to increase physical activity and dietary fat in low-income, culturally diverse students Students were assigned to the intervention or control group based on classroom assignment Intervention: eight internet sessions with four 2-3 minute videos along with computer-generated feedback and tailored individual feedback via emails Outcomes: physical activity, percentage dietary fat.	Intervention participants who completed more than half the sessions increased moderate/vigorous physical activity by 22 minutes and decreased dietary fat by 0.8%.
Haerens et al.[18, 24]	Design: Cluster RCT Setting: School Location: West Flanders, Belgium Duration: Two years	Schools: N= 15 Students: N=2840 11-15 years (mean age: 13.1±0.81 years); 63% males.	Aim: evaluate the effectiveness of a two-year middle school physical activity and healthy eating intervention 15 schools were randomised to receive intervention (intervention alone or intervention with parent support) or control condition Intervention: healthy eating and physical activity was promoted in each school and students received an individual physical fitness test and a computer-tailored intervention for physical activity and fat and fruit intake Intervention with parents: healthy eating and physical activity information was provided in school newsletter and a CD-ROM with the adult computer-tailored intervention Outcomes at baseline, one year and two years: BMI, BMI z-score, self-reported physical activity (and as assessed by accelerometers in one sub-sample), dietary intake (fat, fruit, water and soft drinks).	In girls, BMI and BMI z-score increased significantly less in the intervention group with parent support compared with the control or intervention only groups. No significant positive intervention effects on body mass were found in boys At one and two years, significant positive effects on physical activity in both genders and on fat intake in girls were observed. No significant positive intervention effects on fruit, soft drink and water consumption.

Study	Design	Participants	Intervention description	Key findings
Jago et al.[25]	Design: Cluster RCT Setting: Community (troop meetings) and Internet (at home) Location: Texas, US Duration: Nine weeks	Troops: N=42 Boy scouts: N=473 10-14 years (mean age: 13.0 years); Boy Scouts.	Aim: assess the immediate and six-month effect of a Boy Scout-based physical activity intervention using limited troop time and an internet program targeting physical activity self efficacy and preference change Nine-week intervention: 20-minute weekly skill building activities at troop meetings and twice-weekly internet-based role modelling, goal setting, review and problem-solving Outcomes at baseline, nine weeks and six months: amount of physical activity, self efficacy, and preferences.	The intervention resulted in a 12-minute increase in light intensity physical activity and a trend towards a 12-minute decrease in sedentary behaviour in spring participants No significant change was observed among fall intervention participants or on moderate/vigorous physical activity.
Jones et al.[26]	Design: RCT Setting: Internet Location: Idaho & California, US Duration:16 weeks	N=105 students from 2 public schools. High school students at risk for overweight (mean age: 15.1±1.0 years); 65% males; 64% Caucasian.	Aim: determine the effects of an internet-facilitated, weight management program on reducing binge eating and overeating and preventing weight gain in students at risk of overweight Students were randomly assigned to the online intervention (StudentBodies2-BED) or the wait list control group Intervention: 16-weekly psychoeducational and behavioural interactive internet intervention and asynchronous discussion group facilitated by a research assistant Outcomes at baseline, 16 weeks and nine months: BMI, BMI z-score and binge eating behaviour.	Significant reductions in BMI and BMI z-score in intervention group compared with control group Significant reduction in objective and subjective binge episodes and weight and shape concerns in the intervention group.

Study	Design	Participants	Intervention description	Key findings
Long et al.[27]	Design: Quasi-experimental, pre-test post-test Setting: School Location: Texas, US Duration: One month	N=121 12-16 years (median age: 13 years); 52% females; 30% Caucasian.	Aim: test the effectiveness of a classroom and web intervention on self efficacy for healthy eating and to examine the relationships in the hypothesised model of eating behaviour Students were assigned to the intervention or comparison group based on study feasibility Intervention: five hours of web-based interactive nutrition education and 10 hours of behaviourally-based, activity-oriented classroom curriculum Comparison: nutrition education embedded in the standard school curriculum Outcomes at baseline and one month: self efficacy for healthy eating, dietary knowledge, food choices, food intake.	The intervention group had higher self efficacy for healthy eating, greater dietary knowledge, and healthier usual food choices than the comparison group No difference was observed between groups in food consumption.
Luce et al.[28]	Design: Feasibility study Setting: School and internet Location: California, US Duration: Not detailed	N=174 students 10th grade females; 57% Caucasian; mean BMI: 22.6±4.2.	Aim: determine the feasibility of conducting online screening and providing individualised feedback to female students Students' level of risk for developing an eating disorder or becoming obese was assessed online and students were invited to participate in one of four interventions appropriate to their risk [universal core health curriculum, targeted body image (BI) enhancement curriculum, targeted weight management (WM) curriculum, and combined BI and WM curriculum]. All interventions incorporated online components. Only the core and BI interventions were delivered Outcomes: weight and shape concerns.	Over half of participants identified as being at risk of overweight or developing an eating disorder chose to receive the recommended targeted curricula All groups showed significant improvements in weight and shape concerns.
Marks et al.[19]	Design: RCT Setting: Home	N=319 students Females in grades	Aim: compare the effectiveness of web versus print media for physical activity promotion.	Both intervention groups showed significant changes in physical

Study	Design	Participants	Intervention description	Key findings
	Location: North Carolina, US Duration: Two weeks	six to eight; mean age web group: 12.2±1.0 years, print group: 12.1± 0.9 years; ~50% black.	Participants in the intervention group asked to consult materials at least four times in two weeks Web intervention: participants were provided password protected access to an adapted, interactive *LifeBytes* website Print intervention: participants received a print workbook containing identical content and graphics to the website Outcomes at baseline and two weeks: physical activity self efficacy, physical activity intentions, self-reported physical activity.	activity self efficacy and intentions The print group demonstrated significantly greater increases in intentions compared with the web group Self-reported physical activity increased significantly in the print group only.
Russ et al.[29]	Design: Non-RCT Setting: Rural high school Location: Virginia, US Duration: Not detailed, assuming six weeks	N=41 students Females from two 10th grade classes; 20% of participants' parents completed four years of college.	Aim: examine the feasibility and preliminary efficacy of a prototype internet-based health behaviour change program focused on nutrition Participants were assigned to the *Eat4Life* internet-based behaviour program (N=18) or comparison condition (N=23) based on computer lab availability Intervention: five-weekly, 15- to 20-minute interactive modules targeting healthy eating and physical activity, including goal setting and designed as a teen online magazine; both graphic and personalised online feedback provided Comparison group: basic health curriculum Outcomes assessed at baseline and five weeks: regular meals, dietary intake of fruit and vegetables, breads and cereals, high fat snacks, high fat dairy, and soda drinks.	The internet-based health behaviour program was effective in making positive changes in target foods except for intake of soda drinks compared to controls.
Winett et al.[30]	Design: Non-RCT Setting: Rural high school Location: Virginia, US	N=180 students. Females from four 9th grade classes (mean age: 14.9	Aim: examine the efficacy of an internet-based health behaviour change program (including new content) focused on nutrition and physical activity Participants were assigned to the *Eat4Life* internet-based	The internet-based health behaviour program was effective in making positive changes in several target nutrition areas (regular meals, fruit and vegetables, breads

Study	Design	Participants	Intervention description	Key findings
	Duration: Program run each semester during one academic year.	years) and from four 10th grade classes (mean age: 15.9 years) years.	behaviour program (N=103) or comparison (N=77) condition based on computer lab availability Intervention: six-weekly, 15- to 20-minute interactive modules targeting healthy eating, including goal setting and designed as a teen online magazine; both graphic and personalised online feedback provided Comparison group: basic health curriculum Outcomes assessed at baseline and 6 weeks:regular meals, dietary intake of fruit and vegetables, breads and cereals, high fat snacks, high fat dairy, soda drinks, fast food (based on a sub-sample of 39 students) and aerobic activity.	and cereals, fibre, soda drinks, fast food) and physical activity.

Table 2. Summary of adolescent eating disorder interventions

Study	Design	Participants	Intervention description	Key findings
Bruning Brown et al.[31]	Design: non-RCT Setting: Internet (at school for students) Location: California, US Duration: Eight weeks for students; four weeks for parents	Students: N=153 Females; 14 to 16 years (mean age: 15.1±0.4 years); 56% Caucasian Parents: N=69.	Aim: (a) evaluate the effectiveness of *Student Bodies* provided to a high school class and (b) determine the efficacy of a component addressing parents of students participating in the program Students were assigned to either the internet intervention group or a comparison group, while parents were assigned to either the parent internet intervention or a wait list control group (to receive the intervention after the follow-up period) Student intervention: eight, 1-hour weekly psychoeducational internet sessions with personalised feedback and asynchronous discussion group Parent intervention: an unstructured educational internet program, which participants had 4 weeks to complete Outcomes at baseline, two months and 18 months (students only): measures of body image, body dissatisfaction, and knowledge, and in parents attitutes towards weight and shape.	Significantly reduced eating restraint was reported and greater increases in knowledge were observed in intervention students compared with controls Intervention parents significantly decreased critical weight and shape attitudes.
Heinicke et al.[32]	Design: RCT Setting: Internet Location: Victoria and NSW, Australia Duration: Six weeks	N=83 students Females with body image or eating problems; aged 12-18 years (mean age: 14.4±1.5); mainly Caucasian.	Aim: evaluate the outcomes of an online group body image and disordered eating program (*My Body, My Life: Body Image Program for Adolescent Girls)* compared to a delayed treatment control Intervention: six, 90-minute weekly group online sessions facilitated by a therapist and self-help manual Outcomes at baseline, six to eight weeks, two months and six months: measures of body dissatisfaction, disordered eating and psychological functioning.	Clinically significant improvements in body dissatisfaction, disordered eating and depression post-intervention and maintained at six-month follow up.

Table 3. Summary of adolescent smoking interventions

Study	Design	Participants	Intervention description	Key findings
Ausems et al.[34]	Design: Cluster RCT Setting: School and outside of school (computer-based) Location: Netherlands Duration: 18 months	Schools: N=36 Students: N=2376 12-16 years (mean age: 13.1 years); 52% males.	Aim: evaluate the effects on smoking prevention of an existing in-school program, a computer-tailored out-of-school program and a combined in-school and out-of-school program among Dutch vocational school students Schools were randomly assigned to the in-school (N=9), out-of-school (N=8), combined (N=10) or control (N=9) condition Intervention: three 50-minute classroom lessons and/or three computer-tailored letters with smoking prevention messages mailed to students' homes Outcomes at baseline, six, 12 and 18 months: proximal (attitudinal beliefs, social influences, self efficacy, smoking behaviour) and distal (demographic) factors of smoking and smoking initiation rates.	Significant reduction in smoking initiation in the computer-tailored out-of-school intervention at 18 months compared with controls No additional effect of the combined intervention.
Aveyard et al.[35-36]	Design: Cluster RCT Setting: School (computer-based) Location: West Midlands, UK Duration: Two years	Schools: N=52 Students: N=8352 13-14 years; 50% females; 86% Caucasian.	Aim: evaluate the effects of classroom lessons and interactive computer smoking prevention sessions among British adolescents Schools were randomly assigned to the control (N=26) or school intervention group (N=26) Intervention: three 1-hour classroom lessons and three interactive computer sessions delivered at school Outcomes at baseline, one year and two years: smoking status and positive change in stage (secondary outcome).	The classroom and interactive computer program intervention had no significant effect on change of stage and smoking prevention at one or two years.
Buller et al.[37]	Design: Pair matched, RCT Setting: Australian and US	American schools: N=21	Aim: evaluate the effectiveness of Consider this, a smoking prevention internet-based school program.	The internet-based computer program had different outcomes in the American and Australian

Study	Design	Participants	Intervention description	Key findings
	schools (internet-based) Location: Victoria and South Australia (Australia); Colorado and New Mexico (US) Duration: Not reported	American students: N=1020; grades 6 and 7; 51% females; 56% Caucasian Australian schools: N=25 Australian students: N=1510; grades 7 to 9; 52% females; 72% Australian or European ancestry.	Paired schools in Australia or America were randomly assigned to the control or intervention group Intervention: six 45- to 60-minute school computer lab sessions, completion of one to six modules containing 73 online activities Outcomes for the American and Australian trials were assessed separately Outcomes at baseline and follow up: 30-day smoking prevalence, self-reported measures of future smoking susceptibility, potential moderators and mediators of program effects.	trials The intervention was effective in reducing 30-day smoking prevalence in the Australian trial but not the American trial The Australian intervention was partly mediated by changing perceived norms about smoking and had a positive program dose-response effect The American trial showed lower expectations of smoking in the future.
Norman et al.[38-39]	Design: RCT Setting: School (internet-based) Location: Toronto, Canada Duration: Six months	Students: N=1402 Grades 9 to 11; 54% males Schools: N=14.	Aim: evaluate the effects of a classroom-based internet-assisted program for smoking prevention and cessation in schools Students were randomly assigned to the control web task (N=728) or internet intervention (N=661) Control group: one-hour classroom session featuring a tool developed by investigators to evaluate the quality of three climate change websites, use of a paper journal, a small group discussion and monthly generic follow up emails for six months Intervention: one-hour classroom session featuring interactive quizzes and self assessments on the “Smoking Zine” website, use of a paper journal, a small group motivational interview and tailored, monthly	The classroom-based internet program and additional motivational components had a significant effect on prevention of heavy smoking in non-smoking adolescents at 6 months.

Study	Design	Participants	Intervention description	Key findings
			follow-up emails for six months Outcomes at baseline, post intervention, three months and six months: resistance to smoking, behavioural intentions to smoke, cigarette use.	
Prokhorov et al.[40]	Design: a four -ear nested cohort, group RCT Setting: School (computer-based) Location: Texas, US Duration: 18 months	Schools: N=16. Students: N=1160. 10th grade; fluent in English.	Aim: evaluate the impact of ASPIRE (A Smoking Prevention Interactive Experience), an interactive CD-ROM-based smoking prevention and cessation curriculum for culturally diverse high school students Schools were randomly assigned to the standard care (N=8) or ASPIRE intervention group (N=8) Standard care group: received the US National Cancer Institute's "Clearing the air" self-help booklet Intervention: an interactive, tailored, CD-ROM-based educational program designed for smokers and non-smokers. Five-weekly 30-minute classroom sessions in one semester and two booster sessions in the following semester Outcomes: rate of smoking initiation and smoking behaviour at 18 months (primary outcomes); decisional balance, temptations to smoke, self efficacy, aids to smoking, peer and parental smoking at baseline (secondary outcomes).	The computer-based smoking prevention and cessation intervention was effective in preventing smoking initiation, among culturally diverse high school students at 18 months Students in the intervention group showed higher decisional balance against smoking and decreased temptations to smoke at baseline.
Wood et al.[41]	Design: Before and after descriptive study Setting: School and out of school (website component) Location: Perth, Australia	Average number of schools surveyed at each of five different time points: N=9 to 29 Average number	Aim: evaluate the effects of Smarter than Smoking, a state wide multi-strategy program, on smoking prevalence among 10 to 15year olds in Western Australia Schools to be surveyed were randomly selected from Perth metropolitan and regional areas while face-to-face street intercept surveys of 14 and 15year olds were conducted in the Perth metropolitan area only	The state wide multi-strategy program including an interactive website was effective in preventing smoking initiation and decreasing smoking prevalence in young Western Australians.

Study	Design	Participants	Intervention description	Key findings
	Duration: Ten years	of 12 to 15 year old students surveyed per school at each of five different time points: N=72 to 204.	Intervention: a state wide, multi-strategy program including mass media communications, school-based education, health sponsorship, publications, merchandise, advocacy and an interactive youth website. The OxyGen website included information about smoking and interactive educational activities Outcomes: smoking prevalence, media awareness and attitudes towards smoking and campaign messages.	