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Electronic Media-Based Health Interventions for Behavior Change in Youth: A Systematic Review

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Abstract

Objective—To assess the type and quality of the studies evaluating the effects of electronic media-based interventions on health and safety behavior change.

Data Sources—Studies were identified from searches in MEDLINE (1950 to September 2010) a and PsycINFO (1967 to September 2010).

Study Selection—Included were published studies of interventions that used electronic media and focused on health/safety behavior change in children aged 18 years or younger.

Intervention—Electronic media-based intervention.

Main Outcome Measure—Health or safety behavior change.

Results—Nineteen studies met criteria and focused on at least one behavior change outcome. Of these studies, 7 employed interventions related to physical activity and/or nutrition, 6 focused on asthma, 3 focused on safety behaviors, 2 focused on sexual risk behaviors, and 1 targeted diabetes. Seventeen studies reported at least one statistically significant effect on behavior change outcomes, including an increase in fruit, juice, or vegetable consumption, an increase in physical activity, improved asthma self-management, acquisition of street and fire safety skills, and sexual abstinence. Only five of the 19 studies were rated as being of excellent quality.

Conclusions—Our systematic review suggests that interventions using electronic media can improve health/safety behaviors in young people. However, there is a need for higher quality, rigorous interventions that promote behavior change.

Keywords

adolescent; child; health behavior; health promotion; behavior therapy; randomized controlled trials; videogame

Introduction

Traditional forms of electronic media, such as TV and radio, have been shown to encourage behavior change. Previous studies have demonstrated that their use can increase physical activity[1] and reduce disruptive behavioral problems.[2] However, other types of media, such as computer or videogames, may be more effective in producing behavior change in that they encourage active engagement and processing of information from the child. On any

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given day, 60% of young people play videogames, including 47% who play on a handheld player or a cell phone, and 39% who play on a console player. Additionally, ninety-nine percent of teenage boys and 94% of teenage girls play videogames.[3] Given their widespread use and interactive capabilities, computer and videogames are an increasingly popular type of electronic media used in health interventions and have been a successful tool for health promotion and management of chronic medical conditions in children and adolescents.[4,5] Although they did not meet the strict criteria for the current review, two papers[6,7] describe how videogame interventions target smoking cessation and asthma in adolescents.

Electronic media-based interventions lend themselves to experiential learning and, when created according to established health promotion and instructional design principles, offer distinct advantages over conventional methods of health education.[4] Because of their repetitive nature, electronic media-based interventions have the ability to expose the individual to educational content to reinforce learning. Additionally, electronic media-based interventions can be personalized through the creation of avatars and virtual identities. Lastly, these interventions have interactive capability that can provide immediate feedback and increase player engagement. Accordingly, electronic media-based interventions may be an ideal platform for improving health outcomes for adolescents. However, little research has been done on the efficacy of electronic media-based interventions, especially on their effect on health or safety behavior.

The aim of this study is to systematically review the literature to identify and evaluate electronic media-based interventions focused on promoting health and safety behavior change in youth. While several recent systematic reviews[8–10] have been conducted to evaluate the effectiveness of electronic media-based interventions on health outcomes, these reviews were limited to videogames only as the form of intervention [12,13] or to only one specific health outcome. In addition, many reviews did not include safety behavior outcomes,[13,14, 8–10] or youth populations.[8] The current review expands upon previous reviews by including studies that specifically focus on youth, use electronic-media-based interventions as part of the study, and examine both health and safety behavior outcomes.

METHODS

Search Strategies

We conducted a search on September 29, 2010 of the electronic databases MEDLINE (from1950) and PsycINFO (from 1967) through September 2012 for published studies. Keywords used to locate the studies including the Specific Medical Subject Headings, terms, and text words in MEDLINE and PsycINFO (Table 1) used to describe concepts of Multimedia/Games and Health Behavior. We used the search terms to include the domains of: health behavior, multimedia/games, and children. Our search was limited to the English language, randomized controlled trials, and all children ages 0–18 years.

Inclusion Criteria

Published studies were included if they met all of the following five criteria: 1) English language; 2) human subjects; 3) youth sample (≤ 18 years old for MEDLINE, ≤ 17 years old for PsycINFO); 4) focus on health behavior change, safety, or education; and 5) incorporation of an electronic media-based intervention.

Through an electronic review process, four reviewers independently applied these criteria to all abstracts. If it was not clear from the abstract alone whether it met inclusion criteria, the full paper was reviewed by the team. Selected bibliographies were reviewed for additional manuscripts. To assess reviewer agreement with the abstract review process, each author independently conducted a ten percent random review of the abstracts (N = 41). This

determined a simple kappa statistic of 0.66 indicating fair to good agreement between reviewers.[11] In addition to this kappa score, in cases of disagreement, the reviewers opted to examine the full papers and in reviewing the full papers, 100% consensus was reached on whether a paper should be included in the overall review.

Data extraction

Before extracting data, we piloted and revised extraction forms as a group prior to applying to all publications. The following data were extracted by the four reviewers: target health condition, target health change, type of electronic media, demographics, treatment setting, length of follow -up, and descriptions of interventions and outcomes. When reported, quantitative data including appropriate statistical test results for outcomes were extracted. We defined electronic media as interactive content that is accessed electronically, including content through computer and video console games, video clips, CD-ROM, and the internet. Additionally, we evaluated change in behavior as it related to a health or safety measure.

Quality of evidence

We used the Oxford Quality Scoring System[12] to evaluate the quality of each study. This three item instrument was developed specifically to assess the quality of randomized controlled trials and has been used in many studies.[13–15] Advantages of this scale include that it is easy to use, has established reliability and external validity, and contains many of the important elements that have been shown to correlate with bias.[7] Each researcher independently evaluated each study by allocating points for quality related to randomization, blinding, and inclusion of a description of participants who withdrew or dropped out of the study. Studies with a score of 0–2 were considered poor quality and those with a score of greater than 2 were considered excellent quality.

RESULTS

The search identified 516 abstracts. After excluding duplicates (n=110), 406 abstracts remained. Fifteen additional manuscripts were identified through review of bibliographies, resulting in a total of 421 articles. Of the 421 abstracts, we excluded those which were not in English (n=15), with a non-Human (n=1) and non-child focus (n=43), lacking a health/safety behavior change or health education-targeted intervention (n=309), which was electronic-media-based (n=25).

One manuscript described two distinct studies[16] and two manuscripts described the same study, which resulted in the identification of 28 unique eligible studies (Figure 1). Because we were interested in studies that included actual behavior change outcomes, we restricted our analysis to studies that included at least one behavior change outcome. We defined a behavior change outcome as an outcome that included an observable and measurable modification of an action by a person that related to health or safety promotion. Of the 28 eligible studies, 19[17–35] studies included at least one health/safety behavior change outcome. The remaining 9[16,36–42] studies included outcomes that were related to behavior change such as knowledge, self-efficacy, attitudes, and perception, but lacked a behavior change outcome.

Description of studies with behavior change outcomes

The 19 studies that included a behavior change outcome varied substantially in target condition, study design and outcome measures (Table 2). To maximize clarity, we organized our findings by health or safety condition. A complete table is available online (eTable 1). In summary, 7(37%)[29–35] studies employed interventions aimed to improve physical activity and/or nutrition, 6 (32%)[23–28] asthma or lung function, 3 (16%) [20–22] safety behaviors 2

(11%) [18,19] sexual risk behaviors, and 1 (5%)[17] diabetes. Study settings included clinical (n=7), school (n=7), home (n=3), and other settings (n=2). Seventeen studies (89%) reported the age range of subjects, which ranged from 3 years[23] to 18 years. [19,31,32] Two studies[18,33] reported the mean age of subjects (m=12.47 years, m=13 years) and reported that subjects in the studies were middle school students. The number of participants in the studies ranged from five[20] to 1876 participants.[29] Eleven (58%) of the studies[20–23,25–29,34,35] employed computer games or simulator as the media structure for their intervention, 3 (16%) studies[17,24,31] utilized console videogames, 2 (11%) studies[30,32] included an internet -based program, game or virtual reality world, 2 (11%) studies[19,33] incorporated video clips or an interactive video as part of their intervention program, and 1 (5%) [18] integrated computer -based elements into the intervention. Follow-up duration varied from 1 week[20,22] to 15.6 months. [28]

Target Conditions

Nutrition/Physical Activity—Seven studies[29–35] reported behavior change outcomes related to nutrition and physical activity. Three (43%) of the studies included a computer-based game, one (14%) utilized a console videogame, one (14%) employed an internet-based program, one (14%) incorporated an internet game, and one (14%) integrated video clips as part of the intervention. Five studies included a control group. Outcomes evaluating dietary intake included consumption of fruit, vegetables, 100% juice, dairy, sweets/sugars, carbohydrates, fat, protein, and fiber. Other outcomes related to nutrition included nutrition self-care practices and nutritional status. Two studies[29,34] reported significant increases in fruit and vegetable consumption, (fruit, 0.26±0.05, $p<0.001$; vegetables, 0.06 ±0.03, $p<0.05$), (fruits and vegetables, 80.4% vs. 76.1%, $p=.05$), respectively. One study[34] also found a statistically significant increase in 100% juice consumption ($p<0.05$) in experimental subjects when compared to the control subjects. One study[33] reported an increase in daily diary product consumption ($p=0.001$) and a decrease in daily consumption of sweets/sugars ($p<0.001$). Another study[29] found significant differences in dietary intake between the experimental and control group in relation to more carbohydrate (46.4% vs. 45.7%, $p<0.05$), less fat (37.1% vs. 37.6%, $p<0.05$), less protein (16.5% vs. 16.7%, $p<0.05$), less saccharose (11.5% vs. 12.2%, $p<0.001$), more calcium (771 mg vs. 731 mg, $p<0.001$) and more fiber (12.6 mg vs. 12.1 mg, $p<0.05$). One study[30] reported significant differences in nutrition self -care behaviors pre-and post -intervention ($p<0.05$).

Outcomes related to physical activity included changes in sedentary behavior, physical activity, Body Mass Index (BMI) and systolic blood pressure. Two studies[32,33] found that experimental subjects increased their physical activity ($p=.024$; $p=.011$, respectively) and decreased their sedentary behaviors (TV/DVD watching, $p=.024$), (computer use, $p=.002$), (all sedentary behaviors, $p=.051$). Finally, one study[35] reported a significant treatment effect for obesity reduction in girls (BMI)(0.69 ±0.04 in control vs. 0.62 ±0.04 in intervention), and one study[30] reported a significant difference in subjects' systolic blood pressure (113.9 vs. 108.0; Cohen's $d=0.578$, $p<.001$) pre- and post-intervention.

In the four studies that focused on increasing physical activity in youth, reducing sedentary behavior was discussed, including reducing activities involving electronic media, such as computer use and playing video games. One study,[31] which used an interactive dance video as their intervention to reduce BMI in youth, acknowledged that videogames may also increase sedentary time. While this study did not find an association between game play and BMI reduction, two studies[32,33] reported a statistically significant reduction in sedentary behaviors.

Asthma/Lung Function—Six studies[23–28] reported behavior change outcomes related to asthma or lung function. Five (83.3%) of the studies utilized a computer-based asthma game as part of the intervention, and one (16.6%) utilized a console videogame. All six studies included a control group. Outcomes evaluated included asthma self-management skills, asthma symptoms, doctor visits, hospital visits, oral steroid use, school absence, and spirometry performance. Two studies[25,28] reported significant increases in asthma self-management skills in the experimental group compared to the control group ((mean ±SD) in intervention (64.1±7.7) vs. control (57.8±8.8), p=0.008; effect size =0.44, respectively). One study[28] found that experimental subjects had lower asthma symptoms scores following the intervention (t(116) = −1.96, p=.02), significantly lower clinical appointment return rate (p=.04), and children younger than 12 had fewer hospitalizations in the intervention group as compared to the control group. One study[26] report ed lower use of oral steroids in the intervention group as compared to the control (OR 2.96, 95% CI 1.014–8.612, p=.03). Additionally, one study[23] reported successful spirometry performance in the experimental group as compared with the control group (p=.002).

Safety Behaviors—Three studies[20–22] examined behavior change outcomes related to safety behaviors. Two (66%) of the studies utilized a computer-based game about fire and/or street safety skills as part of the intervention, and one (33%) utilized a computer driving simulator program. One study included a control group. Outcomes evaluated included street and fire safety behavior skills and driving performance on a computer simulator. One study[20] reported that all children in the study (N=5) reached 100% accuracy on completing each of the fire safety skills one week after playing the videogame. Similarly, another study[22] reported that 87.5% of subjects were able to perform three out of four steps correctly immediately following the learning session on fire safety skills and 81.3% on street safety skills. At one week post-intervention, 81.3% were able to perform three out of for steps correctly on fire safety skills, and 75.1% of fire safety skills. One study [21] found that computer-based training improved the driving skills of younger inexperienced drivers.

Sexual Risk Behaviors—Two studies[18,19] reported behavior change outcomes related to sexual risk. One study [19] used an interactive video about sexually transmitted infections (STIs) as part of the intervention, and one study[18] utilized computer -based activities as part of a sexual risk reduction program. Both studies included a control group. Outcomes evaluated included sexual initiation, condom use, and STI acquisition. One study[19] found that experimental subjects were more likely to be completely abstinent from sexual activity from baseline to 3 months (OR=2.50, p=0.027). Additionally, this study found that subjects in the experimental group reported fewer condom failures compared to controls (p=−0.02) and were less likely to report STI diagnosis (OR=2.79, p=0.05). Another study[18] reported that subjects in the control group were more likely to have initiated oral, vaginal, or anal sex by the 9th grade (29.9% vs. 23.4%, ARR 1.29; 95% CI: 1.02–1.64 than students in the intervention group. Additionally, students in the control group were more likely to have initiated oral sex (17.6% vs. 10%, ARR 1.76; 95% CI: 1.21–2.56) and to have initiated anal sex (9.9% vs. 3.7%, ARR 2.67; 95% CI: 1.45–4.94) by ninth grade than those in the intervention group.

Diabetes—One study[17] reported behavior change outcomes related to diabetes using a console videogame as its intervention and compared results in a control group. While the results did not reach statistical significance, both self-efficacy ratings of diabetes self-care and urgent doctor visits for diabetes-related problems improved (p=0.08). In addition, Hemoglobin A1C increased in both the experiment and control groups.

Quality of evidence

Five of the 19 studies received a quality score of 3 out of 5 possible points, indicating excellent quality.[18,19,25–27] The remaining 14 studies received a quality score ranging between 0–2, indicating poor quality. All of the five studies that received a score of a "3" received one point each for describing the study as randomized and how the randomization was done and one point for a description of subject withdrawals or dropouts. All of the 6 studies that received a score of "2" received one point for describing the study as randomized and one point for describing withdrawals or dropouts. Of the studies that received a score of "1", three received one point for describing the study as randomized and one study received one point for a description of subject withdrawals or dropouts. None of the studies described blinding. There was generally good agreement between researchers on quality score ranking. When there was not 100% agreement, differences between reviewers were resolved by consensus.

COMMENT

The current review revealed that electronic media interventions have been developed and examined for an array of conditions that are potentially highly relevant and important to the care of youth. Of the 19 studies included in the current review, 17 reported a statistically significant change in health or safety behavior. These results, however, should be interpreted with caution given that the quality assessment of these studies found most of them to be of poor quality. Of the five studies[18,19,25–27] that were of excellent quality, four[18,19,25,26] found statistically significant differences in the treatment group as compared with the control group. While the current review provides support for the use of electronic media for behavior change in youth, it also highlights, based on the quality assessments, that few scientifically rigorous evaluations of electronic media for targeted behavior change in this age group have been conducted.

Although electronic media-based interventions have the potential to promote health and safety behaviors in youth, there may be some potential limitations for accessing these types of interventions outside of school. Because youth from lower income environments are slightly less likely than youth from higher income environments to go online or to report owning a computer,[43] they may have limited access to internet and computer -based interventions. Videogames, however, occupy a prominent position in American life and appear to cross demographic lines with ixty percent of blacks, 61% of whites, and 55% of Hispanics report interactive game playing.[44] Video game playing extends across economic lines as well and is reported by 58% of those with household incomes under $35,000.[3]

Our review has several important limitations. The limited number of randomized controlled trials and heterogeneity of interventions, settings, and behavior change outcomes make it difficult to draw comprehensive conclusions. We were also limited by the variability in the quality of the studies in terms of our ability to determine the efficacy of the different interventions. The primary concerns about study quality centered around external validity, such as failure to report the description of randomization or withdrawals and dropouts. Notably, none of the studies included in this review were blinded, which also reduced their quality rating. Finally, the majority of the data collected specific to behavior change outcomes is based on self-report of the study subjects.

In summary, our study highlights several key gaps in the existing literature. Given their potentially broad applicability, higher quality evaluations of existing electronic-media-based interventions are needed. Of the five studies that received an excellent quality rating, four studies[18,19,25,26] reported a statistically significant change in asthma or sexual risk related behavior. These studies provide excellent models of electronic media-based interventions

that created behavior change in youth. Specifically, these interventions showed improvement in self-management and risk reduction behaviors in young adolescents, which may be an age group that is most amenable to adopting positive health and safety behaviors. We identified a paucity of studies focusing on unintentional injury prevention and promoting decreased alcohol and drug use among youth, despite their significant morbidity and mortality among this demographic. Our review demonstrates a need to assess the effectiveness of using electronic-media-based interventions in different settings. Given their promise for promoting improved health and safety behavior change among youth in various settings, future research should focus on developing, rigorously evaluating, and implementing electronic-media-based interventions.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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References

1. Huhman M, Potter LD, Wong FL, Banspach SW, Duke JC, Heitzler CD. Effects of a mass media campaign to increase physical activity among children: year-1 results of the VERB campaign. Pediatrics. Aug; 2005 116(2):e277–284. [PubMed: 16061581]
2. Sanders MR, Montgomery DT, Brechman-Toussaint ML. The mass media and the prevention of child behavior problems: the evaluation of a television series to promote positive outcomes for parents and their children. J Child Psychol Psychiatry. Oct; 2000 41(7):939–948. [PubMed: 11079436]
3. Teens, video games, and civics: Pew Internet and American Life Project. Sep 16.2008
4. Lieberman DA. Management of chronic pediatric diseases with interactive health games: theory and research findings. J Ambulatory Care Manage. Jan; 2001 24(1):26–38. [PubMed: 11189794]
5. Kato PM, Cole SW, Bradlyn AS, Pollock BH. A video game improves behavioral outcomes in adolescents and young adults with cancer: a randomized trial. Pediatrics. Aug; 2008 122(2):e305–317. [PubMed: 18676516]
6. Tingen MS, Grimling LF, Bennett G, Gibson EM, Renew MM. A pilot study of preadolescents to evaluate a video game-based smoking prevention strategy. Journal of Addictions Nursing. 1997; 9(3):118–124.
7. Lieberman, DA. Three studies of an asthma education video game. Bethesda, MD: 1995.
8. Primack B, Carroll M, McNamara M, et al. Role of video games in improving health-related outcomes. American Journal of Preventive Medicine. 2012; 42(6):630–638. [PubMed: 22608382]
9. Biddiss E, Irwin J. Active video games to promote physical activity in children and youth: a systematic review. Arch Pediatr Adolesc Med. Jul; 2010 164(7):664–672. [PubMed: 20603468]
10. Cushing CC, Steele RG. A meta-analytic review of eHealth interventions for pediatric health promoting and maintaining behaviors. J Pediatr Psychol. Oct; 2010 35(9):937–949. [PubMed: 20392790]
11. Feinstein, A. Principles of Medical Statistics. London, UK: Chapman & Hall/CRC; 2002.
12. Jadad AR, Moore RA, Carroll D, et al. Assessing the quality of reports of randomized clinical trials: is blinding necessary? Control Clin Trials. Feb; 1996 17(1):1–12. [PubMed: 8721797]
13. Halpern, SH.; Douglas, J., editors. Evidence-based Obstetric Anesthesia. Blackwell Publishing Ltd; 2005.

14. Khan KS, Daya S, Jadad A. The importance of quality of primary studies in producing unbiased systematic reviews. Arch Intern Med. Mar 25; 1996 156(6):661–666. [PubMed: 8629879]
15. Moher D, Pham B, Jones A, et al. Does quality of reports of randomised trials affect estimates of intervention efficacy reported in meta-analyses? Lancet. Aug 22; 1998 352(9128):609–613. [PubMed: 9746022]
16. Goodman D, Bradley NL, Paras B, Williamson IJ, Bizzochi J. Video gaming promotes concussion knowledge acquisition in youth hockey players. J Adolesc. Jun; 2006 29(3):351–360. [PubMed: 16169584]
17. Brown SJ, Lieberman DA, Germeny BA, Fan YC, Wilson DM, Pasta DJ. Educational video game for juvenile diabetes: results of a controlled trial. Medical Informatics. Jan-Mar;1997 22(1):77–89. [PubMed: 9183781]
18. Tortolero SR, Markham CM, Peskin MF, et al. It's Your Game: Keep It Real: delaying sexual behavior with an effective middle school program. J Adolesc Health. Feb; 2010 46(2):169–179. [PubMed: 20113923]
19. Downs JS, Murray PJ, Bruine de Bruin W, Penrose J, Palmgren C, Fischhoff B. Interactive video behavioral intervention to reduce adolescent females' STD risk: a randomized controlled trial. Soc Sci Med. Oct; 2004 59(8):1561–1572. [PubMed: 15279915]
20. Padgett LS, Strickland D, Coles CD. Case study: using a virtual reality computer game to teach fire safety skills to children diagnosed with fetal alcohol syndrome. J Pediatr Psychol. Jan-Feb;2006 31(1):65–70. [PubMed: 15829610]
21. Fisher DL, Laurie NE, Glaser R, et al. Use of a fixed-base driving simulator to evaluate the effects of experience and PC-based risk awareness training on drivers' decisions. Hum Factors. 2002; 44(2):287–302. [PubMed: 12452274]
22. Coles CD, Strickland DC, Padgett L, Bellmoff L. Games that "work": using computer games to teach alcohol-affected children about fire and street safety. Res Dev Disabil. Oct-Nov;2007 28(5): 518–530. [PubMed: 16965894]
23. Vilozni D, Barker M, Jellouschek H, Heimann G, Blau H. An interactive computer-animated system (SpiroGame) facilitates spirometry in preschool children. Am J Respir Crit Care Med. Dec 15; 2001 164(12):2200–2205. [PubMed: 11751188]
24. Shames RS, Sharek P, Mayer M, et al. Effectiveness of a multicomponent self-management program in at-risk, school-aged children with asthma. Ann Allergy Asthma Immunol. Jun; 2004 92(6):611–618. [PubMed: 15237762]
25. Rubin DH, Leventhal JM, Sadock RT, et al. Educational intervention by computer in childhood asthma: a randomized clinical trial testing the use of a new teaching intervention in childhood asthma. Pediatrics. Jan; 1986 77(1):1–10. [PubMed: 3510016]
26. McPherson AC, Glazebrook C, Forster D, James C, Smyth A. A randomized, controlled trial of an interactive educational computer package for children with asthma. Pediatrics. Apr; 2006 117(4): 1046–1054. [PubMed: 16585298]
27. Huss K, Winkelstein M, Nanda J, Naumann PL, Sloand ED, Huss RW. Computer game for inner-city children does not improve asthma outcomes. J Pediatr Health Care. Mar-Apr;2003 17(2):72–78. [PubMed: 12665729]
28. Bartholomew LK, Gold RS, Parcel GS, et al. Watch, Discover, Think, and Act: evaluation of computer-assisted instruction to improve asthma self-management in inner-city children. Patient Educ Couns. Feb; 2000 39(2–3):269–280. [PubMed: 11040726]
29. Turnin MC, Tauber MT, Couvaras O, et al. Evaluation of microcomputer nutritional teaching games in 1,876 children at school. Diabetes Metab. Sep; 2001 27(4 Pt 1):459–464. [PubMed: 11547219]
30. Moore JB, Pawloski LR, Goldberg P, Kyeung MO, Stoehr A, Baghi H. Childhood obesity study: a pilot study of the effect of the nutrition education program Color My Pyramid. J Sch Nurs. Jun; 2009 25(3):230–239. [PubMed: 19363107]
31. Madsen KA, Yen S, Wlasiuk L, Newman TB, Lustig R. Feasibility of a dance videogame to promote weight loss among overweight children and adolescents. Arch Pediatr Adolesc Med. Jan; 2007 161(1):105–107. [PubMed: 17199076]

32. Jago R, Baranowski T, Baranowski JC, et al. Fit for Life Boy Scout badge: outcome evaluation of a troop and Internet intervention. Prev Med. Mar; 2006 42(3):181–187. [PubMed: 16458955]
33. Dunton GF, Lagloire R, Robertson T. Using the RE-AIM framework to evaluate the statewide dissemination of a school-based physical activity and nutrition curriculum: “Exercise Your Options”. Am J Health Promot. Mar-Apr;2009 23(4):229–232. [PubMed: 19288843]
34. Cullen KW, Watson K, Baranowski T, Baranowski JH, Zakeri I. Squire’s Quest: intervention changes occurred at lunch and snack meals. Appetite. Oct; 2005 45(2):148–151. [PubMed: 15927302]
35. Goran MI, Reynolds K. Interactive multimedia for promoting physical activity (IMPACT) in children. Obes Res. Apr; 2005 13(4):762–771. [PubMed: 15897486]
36. Alemi F, Cherry F, Meffert G. Rehearsing decisions may help teenagers: an evaluation of a simulation game. Comput Biol Med. 1989; 19(4):283–290. [PubMed: 2680255]
37. Di Noia J, Schinke S, Pena J, Schwinn T. Evaluation of a computer-mediated intervention to reduce HIV risk among early adolescent females. J Adolesc Health. 2004; 35:62–64. [PubMed: 15193576]
38. Fiscian VS, Obeng EK, Goldstein K, Shea JA, Turner BJ. Adapting a multifaceted U.S. HIV prevention education program for girls in Ghana. AIDS Educ Prev. Feb; 2009 21(1):67–79. [PubMed: 19243232]
39. Paperny DM, Starn JR. Adolescent pregnancy prevention by health education computer games: computer-assisted instruction of knowledge and attitudes. Pediatrics. May; 1989 83(5):742–752. [PubMed: 2654867]
40. Shegog R, Bartholomew LK, Parcel GS, et al. Impact of a computer-assisted education program on factors related to asthma self-management behavior. J Am Med Inform Assoc. Jan-Feb;2001 8(1): 49–61. [PubMed: 11141512]
41. Yawn BP, Algatt-Bergstrom PJ, Yawn RA, et al. An in-school CD-ROM asthma education program. J Sch Health. Apr; 2000 70(4):153–159. [PubMed: 10790839]
42. Yoon SL, Godwin A. Enhancing self-management in children with sickle cell disease through playing a CD-ROM educational game: a pilot study. Pediatr Nurs. 2007 Jan-Feb;33(1):60–63. [PubMed: 17411004]
43. Pew Internet and American Life Project. 2012. Digital divide and bridges: Technology use among youth.
44. Generation, M. [Accessed February 24, 2008.] Media in the lives of 8–18 year olds. A Kaiser Family Foundation Study. http://www.kff.org/entmedia/upload/Generation-M-Media-in-the-Lives-of-8-18-Year-olds-Report.pdf

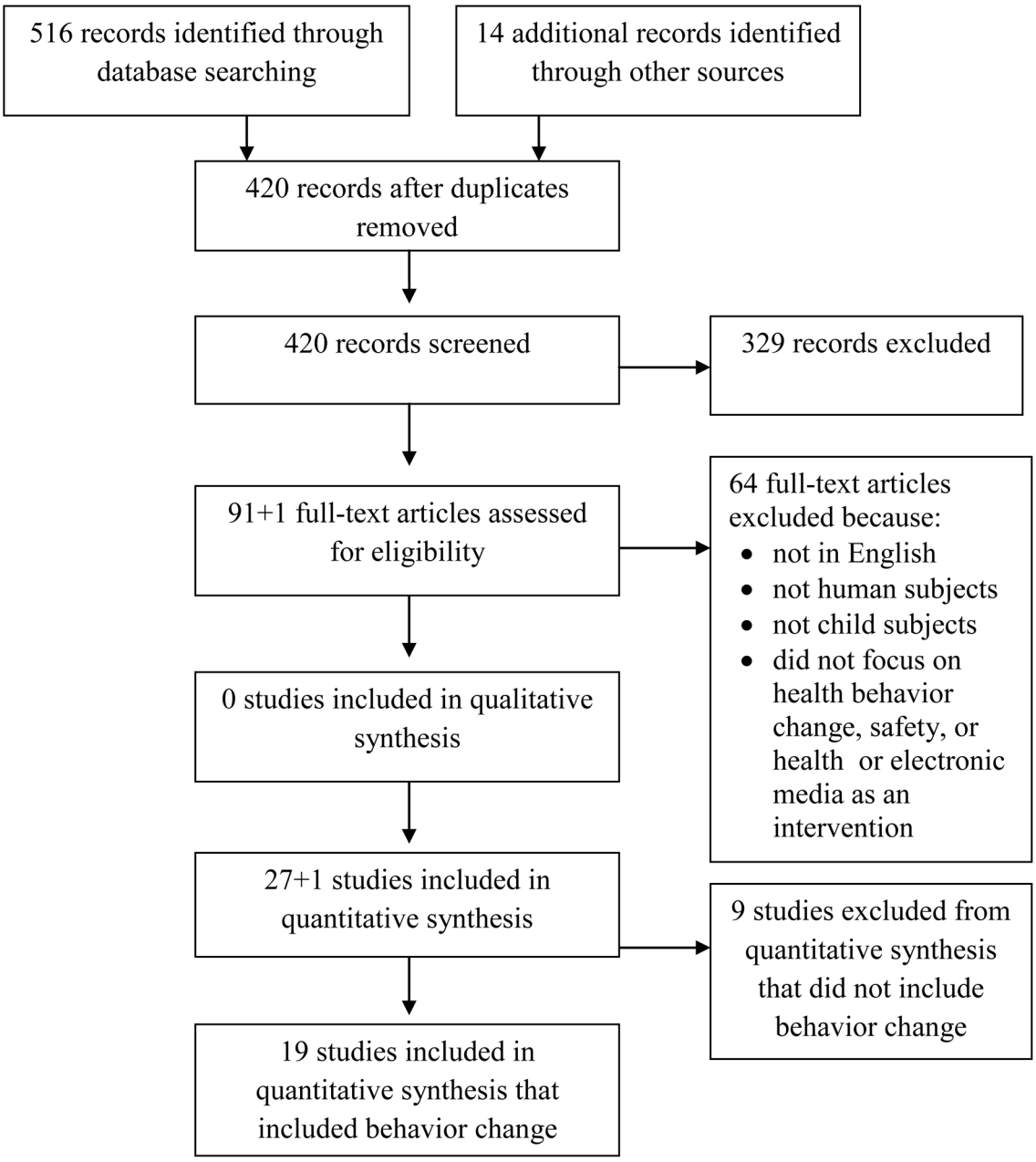

Figure 1.
Flowchart documenting the article selection process

Table 1

Specific controlled vocabulary terms and text words in MEDLINE and PsycINFO used to describe concepts of multimedia/games and health behavior

Concept	Terms	Text Words
Medline		
Multimedia/Games	Videogames	videogame$, videogame$, multimedia game$, computer game$, interactive game$, educational game$, health game $, online game$, learning game$, exergame, interactive computer, interactive game
Health Behavior	Risk reduction behavior, health promotion, health behavior, health education, consumer health information, patient education as topic, sex education	Risk$ reduction, risk$ behavior, risk$ prevent$, health promot$ behavior
PsycINFO		
Multimedia/Games	Simulation games, role playing games, computer simulation, computer games	Videogame$, videogame$, multimedia game$, computer game$, interactive game$, educational game$, health game $, online game$, learning game$, exergame, interactive computer, interactive game
Health Behavior	Health behavior, health promotion, behavior change, health education, risk taking	Health promot$, health behavior, risk$ reduction, risk$ behavior, risk prevent$

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Table 2

Summary of studies utilizing electronic media for health or safety behavior change

Source(Quality Score)	Setting/ Subjects	Media Type	Research Design	Intervention	Control	Results/Conclusions *
Nutrition/Physical Activity						
Cullen et al,[34] 2005 (2)	School; N = 1578 (8-12y)	Computer game	RCT-cluster design	Game play: 10 25 min sessions for 5 wks	No Game	Intervention group consumed more FJV, fruit servings, 100% juice
Dunton et al,[33] 2009 (1)	School; N=683, (M=12.5y)	Video clips	Pilot with pre/post-test	Teacher delivered curriculum w/video clips for 8 sessions	N/A	Intervention group had increased physical activity, daily dairy; decreased TV/DVD and videogame playing/ nonschool-related computer use and sweets/sugar intake
Goran et al,[35] 2005 (2)	School; N= 209 (8.8-11y)	Computer game	RCT-cluster design	Game play/ educational lessons for 8 wks	Educational CD-ROM	Intervention group had decreased BMI in girls but not boys
Jago et al,[32] 2006 (2)	Boy Scouts; N =473 (9-18 y)	Internet	RCT	Internet-based program 2x wk for 9 wks	Fruit & vegetable intervention	Intervention group had increased light physical activity and decreased sedentary behavior
Madsen et al,[31] 2007 (0)	Home; N= 30 (9-18y)	Videogame	Pilot with pre/post-test	Videogame 30 min/d, 5d/wk for 2 mos	N/A	No statistically significant changes in BMI
Moore et al,[30] 2009 (0)	School; N = 126 (9-11y)	Internet game	Quasi- experimental pilot with pre/post-test	Game play for 6 classes over 3 mos period	Didactic presentation of game	Intervention group had increased pre- and post-game measures of self-care behavior, physical activity, and mean systolic blood pressure
Turnin et al,[29] 2001 (1)	School; N = 1876 (7-12y)	Computer game	RCT	Game play and nutritional teaching, 2 hrs/wk for 5 wks	Teaching only	Intervention group had more carbohydrate, less fat, less protein, less saccharose, more calcium, more fiber
Asthma/Lung Function						
Bartholomew et al,[28] 2000 (2)	Clinic; N =133 (7-1y)	Computer game	Randomized trial with pre/post-test	Game play at visits, 40 mins	Usual care	Intervention group had lower post-test symptoms scores, moderated by asthma severity

Source(Quality Score)	Setting/ Subjects	Media Type	Research Design	Intervention	Control	Results/Conclusions *
Huss et al,[27] 2003 (3)	Home; N=148 (7-12 y)	Computer game	RCT	Game play/education	Education only	No statistically significant changes in asthma symptoms
McPherson et al,[26] 2006 (3)	Clinic; N=101 (7-14 y)	Computer game	RCT	Game play/asthma booklet, 90 mins,	Asthma booklet only	Intervention group had lower oral steroid use
Rubin et al,[25] 1986 (3)	Clinic;, N = 65 (7-12y)	Computer game	RCT	Game play, 45 min every 6 wks for 10 mos	Non-asthma computer game	Intervention group had higher asthma behavioral child assessment score
Shames et al,[24] 2004 (2)	Home; N =119 (5-12y)	Console videogame	RCT	Disease management program w/ videogame	Usual care/ videogame	No statistically significant changes in asthma symptoms/ clinical outcomes
Vilozni et al,[23] 2001 (2)	School; N=112 (3-6y)	Computer game	RCT with cross over	Game play for 1 session of 5–10 min	Candle blowing simulation	Intervention group achieved successful spirometry
Safety Behaviors						
Coles et al,[22] 2007 (1)	Clinic; N=32 (4-10y)	Computer game	Randomized pilot with pre/post-test	Game play until mastery of skills (<30 mins)	N/A	No statistically significant differences with fire and street safety game play
Fisher et al,[21] 2002 (0)	Driver's education course; N=45 (16-17y)	Computer simulator program	Controlled study	Computer-based training/driving simulator, 90 min session	No training	Intervention group successfully applied the brakes
Padgett et al,[20] 2006 (0)	Clinic; N=5 (5-7y)	Computer game	Pilot with Pre/post-test	Game play until mastery of skills	N/A	No statistically significant changes with fire safety game play
Sexual Risk Behaviors						
Downs et al,[19] 2004 (3)	Clinic/ hospital; N =300 (14-18 y)	Interactive video	RCT	Interactive video, 30 min session	Content-matched book/brochure	Intervention group reported more complete sexual abstinence, fewer condom failures, and less STI diagnosis
Tortolero et al,[18] 2010 (3)	School; N =907(M=13y)	Computer based program	RCT	Computer-based activities, 12 45 min lessons; 6 homework activities	Regular health classes	Intervention group less likely to have initiated oral, vaginal, or anal sex by 9th grade
Diabetes						
Brown et al,[17] 1997 (1)	Clinic; N = 59 (8-16y)	Console videogame	RCT	Game play at home, (unrestricted game play)	Non-health related game	No statistically significant differences in diabetes outcomes

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* Only statistically significant ($p<0.05$) and medium-large effect sizes reported; Abbreviations: FJV, fruit, juice, vegetable: STIs, sexually transmitted infections