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Review article

The Prevalence of Unwanted Online Sexual Exposure and Solicitation Among Youth: A Meta-Analysis

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A B S T R A C T

Purpose: The objective of this meta-analysis was to provide a synthesis of studies examining the prevalence of unwanted online exposure and solicitation of a sexual nature among youth, and to determine if prevalence varies by youth age, gender, year of study data collection, or study geographical location.

Method: Eligible studies from January 1990 to January 2016 were identified utilizing a comprehensive search strategy. Included studies examined the prevalence of unwanted online exposure and solicitation in youth who ranged from 12 to 16.5 years. Two independent coders extracted all relevant data. Random-effects meta-analyses were used to derive mean prevalence rates.

Results: Thirty-one (37,649 participants) and nine (18,272 participants) samples were included in the syntheses on unwanted online sexual exposure and solicitation, respectively. For online exposure, the mean prevalence rate was 20.3% (95% confidence interval: 17.1–23.4). For online solicitation, the mean prevalence rate was 11.5% (95% confidence interval: 9.4–13.6). Moderator analyses indicated that prevalence rates for unwanted online exposure and solicitation have decreased over time. Prevalence varied as a function of gender (solicitations were higher for males), but not age or geographical location.

Conclusions: Approximately one in five youth experience unwanted online exposure to sexually explicit material and one in nine youth experience online sexual solicitation. Educational campaigns to raise awareness of Internet risks and safety strategies are warranted.

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IMPLICATIONS AND CONTRIBUTION

Study findings indicate that one in five youth experience unwanted online exposure to sexually explicit material, and one in nine youth experience unwanted online solicitation of a sexual nature. This synthesis underscores the ongoing need for educational campaigns to draw attention to Internet risks. It also underscores the need for additional research on the psychological impact of Internet-facilitated sexual encounters.

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In 2015, over 80% of American youth had access to home computers and the Internet [1]. Moreover, children aged 5–16 spend on average 6.5 hours per day on computers, tablets, smartphones, and/or videogame consoles, a number that has doubled over the last two decades [2]. With increased screen time comes concurrent growth in Internet and social media use and exposure [3]. Thus, computers and other electronic devices that facilitate Internet access are a central component of young people's lives [4]. The Internet provides a hub of information, and has the potential to be highly beneficial to youth in terms of greater access to learning opportunities, valuable resources, and positive social interactions with peers. However, the Internet remains a relatively new and mostly unregulated entity, which in turn can place youth at risk of experiencing some of its potential dangers, including unwanted online exposure to sexually explicit pictures or videos, as well as unwanted online solicitation (i.e., requests by a peer or adult to engage in *unwanted* sexual activities or sexual talk online) [5,6].

Youth generally have lower socio-cognitive sophistication compared to adults [7–9]. Thus, they may have less capacity to foresee the potential threats posed by the Internet, which can make them vulnerable to unsolicited and potentially disturbing online content. Studies have demonstrated that these encounters can be psychologically distressing, with 25% of youth reporting that they were considerably distressed or afraid as a result of online solicitation [10]. Thus, while not all youth report online sexual encounters to be traumatizing, a proportion are negatively impacted by these events. As noted by Livingstone and Smith [11], a naiveté regarding these encounters may exist and their impact may be exacerbated by other online use and behavioral characteristics (e.g., high Internet use and talks with strangers online) [12], as well as offline behavioral characteristics (e.g., loneliness, anxiety, and depression) [13]. These complexities highlight the importance of attaining prevalence estimates of unwanted online sexual exposure and solicitation as an important foundation for further understanding risk factors for, as well as consequences of, these potential victimizations.

Formal reports and investigations of Internet-related sexual exposure and solicitation of youth have increased over time [6]. Nationwide campaigns for greater parent and youth education concerning Internet safety behaviors have also emerged [14–16]. The prevalence of unwanted online exposure and solicitation, however, remains unclear, as rates in the extant literature range considerably. For unwanted exposure to sexually explicit material, prevalence rates range from 2% to 70% [17,18]; and for unwanted sexual solicitation, the range is from 2% to 24% [19,20]. This substantial variability can create difficulty in understanding the exact risk posed to youth on the Internet. Reported prevalence rates as high as 70% can also create unnecessary and unwarranted alarm in the public domain. By combining studies via a meta-analysis and deriving a precise estimate across the full body of research, the degree of risk can be derived. This, in turn, will assist in disseminating accurate information to children, adolescents, parents, and helping professionals via educational platforms regarding Internet safety.

Several demographic and methodological factors may account for variability in the reported prevalence of unwanted sexual exposure and solicitation. Although adolescents are cognitively better equipped than preadolescents to implement Internet safety strategies [21–23], their daily Internet use is greater [24], and they are more likely to navigate sites such as chat rooms that may increase their risk of experiencing unwanted online exposure and solicitation [10,25]. Moreover, adolescents, more so than children, own and use mobile smartphones as a way of connecting to the

Internet, with 24% of adolescents reporting that they feel “constantly connected” to the Internet [26]. As youth progress through adolescence and their interest and participation in sexual activities increase [27], they may visit sites with more sexual content, thereby increasing their risk to unwanted exposure and solicitation [28,29]. Additionally, parents may allow adolescents greater online freedom with less monitoring and supervision [30]. For all these reasons, it is expected that as adolescents age, their risk of experiencing unwanted online exposure or solicitation may increase. Gender may also play a role in understanding variability in prevalence, as some studies have found that girls are more likely to be solicited, compared to boys [10]. Finally, conditions for exposure across the globe may vary due to differential access to the Internet, societal norms regarding sexual behavior, and/or government controls. Thus, we also examine geographical location as a potential moderator of between-study variability [31].

It is also important to elucidate whether the degree of risk has increased, decreased, or remained constant over time. The potential dangers of the Internet have been repeatedly highlighted in mainstream media, and warranted or not, concerns about its perils have seized the attention of parents, teachers, health practitioners, child welfare, police, and policy makers, as well as the U.S. Supreme Court [32–36]. This increased attention and focus may in turn result in decreases in the prevalence of unwanted online exposure and solicitation among youth [19].

Meta-analyses are the best method in clinical science for resolving discrepancies in the literature, and for testing under which conditions effect sizes are particularly strong or weak (i.e., moderator analyses). Thus, the goals of the current study are to: (1) attain a mean estimate of the prevalence of both unwanted online exposure to sexually explicit material and solicitation via a meta-analytic synthesis of the literature amassed to date; and (2) examine potential moderators that may amplify or attenuate prevalence rates, including youth age and gender, as well as year of data collection, and geographical location.

Methods

Definitional criteria

There is a notable absence of gold standard definitional criteria in research investigating online encounters of a sexual nature among youth. The current study adopted the definitional elements provided by researchers at the Crimes Against Children Research Center [32], who define *unwanted* online exposure as exposure to sexually explicit pictures and/or videos via pop-up windows, spam e-mails, Web site links, etc., without seeking or expecting sexual material. We also include *accidental* exposure under this umbrella term as both unwanted and accidental imply youth intent was lacking and unplanned. Online solicitation is defined as requests to engage in *unwanted* sexual activities or sexual talk, or to provide sexual information [4] to another individual (including peers and adults). All studies included in the current meta-analysis assessed experiences of *unwanted and/or unsolicited* online exposure and solicitation that were consistent with these operational criteria, though definitional precision varied across studies (see Table 1).

Search strategy

This meta-analysis was based on recommendations and standards set by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (<http://www.prismstatement.org>) [37]. A

Table 1
Study characteristics for all studies included in the meta-analyses on unwanted online exposure and solicitation

Study	N	Age	Measure	Geographical location	Publication status	Definition of exposure/solicitation
Baumgartner (2010) [20]	1,765	14.5	Solicitation	Netherlands	UP ^a	Unwanted requests to talk about/do something sexual
Chang (2015)	1,864	12.8	Solicitation	Taiwan	PR	Unwanted requests to talk about/do something sexual
Dowdell (2011)	2,481	15.6	Solicitation	USA	PR	Unwanted requests to talk about something sexual
Flander (2009) [79]	2,880	12.0	Exposure	Croatia	PR	Unwanted exposure to sexually explicit material
Helweg-Larsen (2012) [80]	4,093	15.3	Solicitation	Denmark	PR	Online victimization; sexually solicited by an unknown person
Jones (2012) [62], ^b	1,560	14.2	Exposure	USA	PR	Unwanted exposure to sexually explicit material
Livingstone (2005) [18]	1,511	13.0	Exposure	United Kingdom	UP ^a	Accidentally viewed sexually explicit material
Livingstone (2011) [38], ^c	25,142	13.0	Exposure	Multinational (Europe)	UP ^a	Accidentally viewed sexually explicit material
Mishna (2010)	2,150	13.6	Solicitation	Canada	PR	Unwanted exposure to sexually explicit material or requests to do something sexual
Mitchell (2004) [65], ^b	1,501	14.4	Both	USA	PR	Unwanted requests to talk about/do something sexual; Unwanted exposure to sexually explicit material
Mitchell (2007) [4], ^b	1,500	16.5	Both	USA	PR	Unwanted requests to talk about/do something sexual; Unwanted exposure to sexually explicit material
Mitchell (2013) [19], ^b	1,560	14.2	Solicitation	USA	PR	Unwanted requests to talk about/do something sexual
Montiel (2015) [81]	3,897	14.5	Exposure	Spain	PR	Unwanted exposure to sexually explicit material
Ybarra (2011) [82]	1,358	12.6	Solicitation	USA	PR	Unwanted requests to talk about sex or do something sexual

PR = peer reviewed; UP = unpublished.

^a Unpublished sources include reports prepared for various government, educational, and private agencies, as well as articles furnished to authors for internal research.

^b The YISS-1, YISS-2, and YISS-3 studies had three independent samples of 1,500 youth, collected in 5-year intervals. Each sample was entered separately in the meta-analysis as none were overlapping.

^c The EU Kids Online study had representation from 25 European countries, Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Ireland, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Turkey, and the United Kingdom.

systematic search for articles published between January 1990 and January 2016 was conducted in PsycINFO, Medline, Social Work Abstracts, and ProQuest. We selected a search start date of 1990 as the first Web browsing computer program (world wide web) became available to the public at this time. Database-specific subject headings were selected to identify relevant research. Keywords included: prevalence, AND Internet OR online, AND exploit*, exposure*, abuse, sexual, pornography, solicit*, and grooming. The search was restricted to youth under the age of 18. No language or publication restrictions were applied to the search strategy. In addition to database reviews, references of all articles meeting study inclusion were reviewed for additional studies, and online reports were also searched [38].

Inclusion criteria

An article was retained if it fulfilled the following inclusion criteria: (1) examined the prevalence of unwanted online sexual exposure or solicitation; (2) the age of study participants was below 18; and (3) the study was available in English. To identify studies meeting inclusion criteria, two authors reviewed the titles and abstracts identified in the search strategy. When titles and abstracts were insufficient to determine inclusion criteria, full articles were retrieved to make a final determination of inclusion or exclusion.

Data extraction

Data were extracted from all eligible studies using a standard data extraction form. To ensure accuracy and reliability, a proportion of the studies (20%) were verified by a second coder, and discrepancies were resolved through conferencing. Extracted data included prevalence and sample size, as well as potential moderators, including: (a) child age (continuously as a mean); (b) child gender (% of males in a sample); (c) year of study data collection; and (d) geographical location examined as North America versus regions of Europe (as defined by the United Nations [39]).

It is critical in meta-analyses to ensure that prevalence is only represented once per dataset. Some studies published multiple articles using the same dataset. In such cases, each dataset was only represented once, by selecting the study with the largest sample size and most comprehensive data extraction information. Two studies merit particular mention when discussing potentially overlapping samples. First, the YISS-1, YISS-2, and YISS-3 studies had three separate samples of 1,500 youth, collected over 5-year intervals (2000, 2005, and 2010) [19]. These samples had nonoverlapping participants, thus each sample was entered separately in the meta-analysis. Second, the EU Kids Online study was a random stratified survey sample of approximately 1,000 children (aged 9–16) from 25 European countries, including Austria, Belgium, Bulgaria, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Italy, Ireland, Lithuania, Netherlands, Norway, Poland, Portugal, Romania, Slovenia, Spain, Sweden, Turkey, and the United Kingdom. Each country is entered separately in the meta-analysis as no data are overlapping and population parameters are expected to vary across countries.

Study quality

An assessment of study quality was conducted based on a 7-point quality assessment scale using modified tools based on previous meta-analyses [40–42]. Articles were given a score of 0 (“No”) or 1 (“Yes”) for each criterion, and summed to give a total score out of 7. Studies were considered low, moderate, or high quality based on the following classification system [43], ≤ 2 = low quality, 3 or 4 = moderate, and 5–7 = high quality, respectively. Studies deemed to have low methodological quality were removed from the meta-analyses.

Sensitivity analysis

In meta-analyses, it is important to determine if there are extreme values influencing the mean prevalence (i.e., effect size) [44]. Outlier detection was examined in SPSS (version 23.0) using

visual inspection of box plots [45]. If detected, outliers will be removed from the calculation of the effect size to determine whether heterogeneity of derived effect sizes is due to the influence of these outliers.

Meta-analysis

Of interest in each study was the prevalence of unwanted online exposure and solicitation in youth under the age of 18, which represented the effect size. All data extracted were analyzed in Comprehensive Meta-Analysis (3.0). Comprehensive Meta-Analysis transforms the prevalence into a logit event rate effect size with a computed standard error. Subsequently, effect sizes are weighted by the inverse of their variance, giving greater weight to studies with larger sample sizes and thus, more precise estimates. Finally, logits are retransformed into proportions to facilitate ease of interpretation. Additionally, 95% confidence intervals (CIs) around the mean point estimate are provided. Random effect models, a more conservative estimate of the mean prevalence, were selected to calculate effect sizes. Random effect models assume that random differences exist in study settings and methods of data collection, including study and subject level sampling error [46]. This choice of

method is consistent with the suggestion that variability across studies examining elements of child maltreatment and exposure may be the result of common differences in methodological approaches and operational definitions utilized in this area of research [45,47].

To assess for heterogeneity of effect sizes, the Q and I^2 statistics were computed. Sample and study-level variables were examined using the Q statistic (categorical moderators) and meta-regression (continuous moderators) to account for potential heterogeneity of effect sizes [48,49]. Publication bias was assessed using Egger's test and inspection of funnel plots [50].

Results

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses flow diagram [37] detailing the search strategy and resulting outcome can be found in Figure 1. The initial search strategy yielded 1,031 titles/abstracts, and 28 records were identified through other sources including citations in other articles and online reports. Following the removal of duplicate records, 930 titles/abstracts were screened with the predetermined inclusion criteria. A total of 101 publications were identified for inclusion during the screening process and their full text articles were

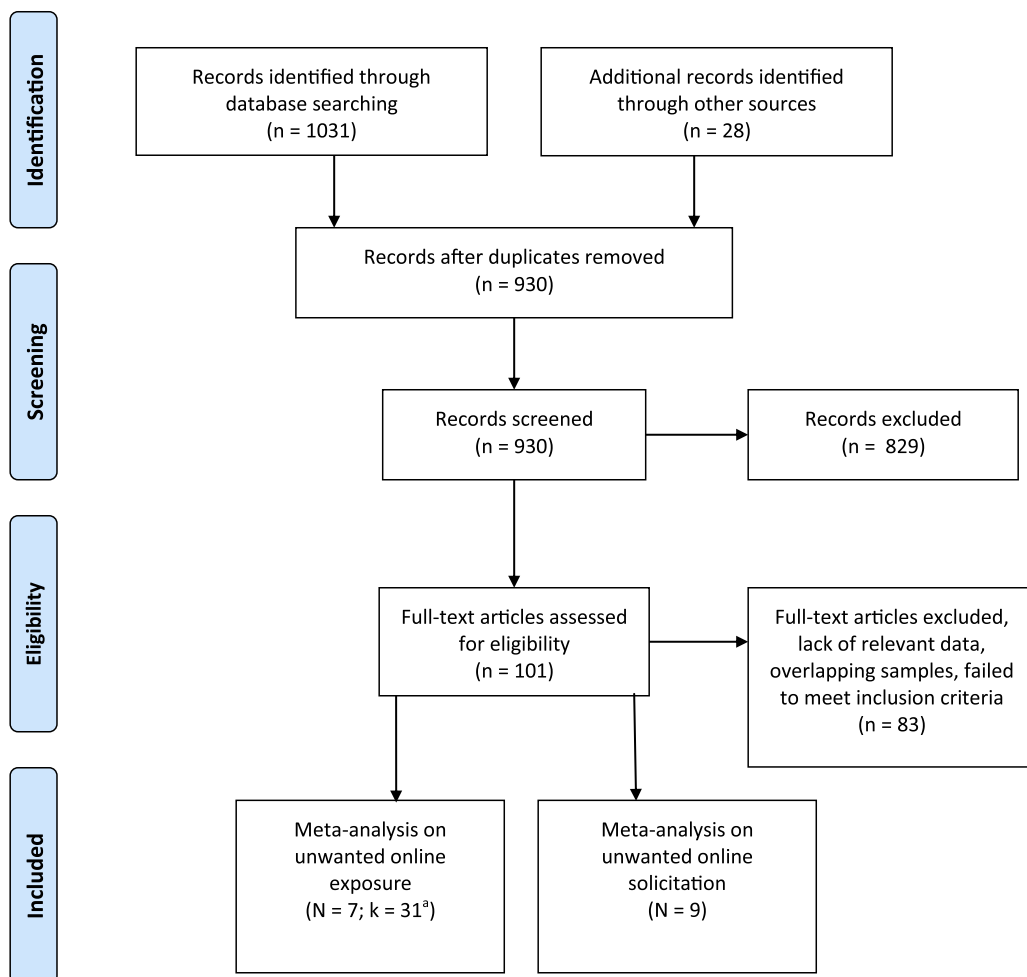


Figure 1. PRISMA flow diagram detailing the search strategy.

^aN = total studies included, k = number of samples when EU Kids Online [38] study is stratified by country.

retrieved, with 15 studies ultimately meeting inclusion criteria after evaluation of the full text.

A final step for inclusion in the meta-analysis was adequate study quality. All 15 studies were reviewed and the mean quality score across all studies was 5.5 out of 7 (see Supplemental Tables 1 and 2). One study fell in the low quality range (≤ 2) [17], three studies in the moderate quality range (3–4), and the remaining eleven studies in the high quality range (≤ 5). The study falling in the low quality range was excluded from the meta-analysis [17], leaving 14 studies meeting full inclusion criterion. Two of these fourteen studies had data for both unwanted online exposure and solicitation. Thus, nine studies (with 18,272 participants) were included in the meta-analysis on unwanted online sexual solicitation and seven studies with 31 nonoverlapping sample estimates (with 37,649 participants) were included in the meta-analysis on unwanted online exposure. Thirty-one samples were included in the latter meta-analysis as the Livingstone et al. [38] study was stratified by 25 countries who independently collected data on unwanted online sexual exposure.

Characteristics of included studies

The mean age of children was 14.01 years (range = 12.0–16.5), and the average percentage of males across studies was 49.5%. The year of data collection on the prevalence of online exposure and solicitation ranged from 2004 to 2015. Six studies were from the United States (42.9%) and six from Europe (42.9%). Sixty-one percent of the studies used questionnaire measures, and 29% used telephone interviews.

Meta-analysis of the prevalence of unwanted online exposure to sexually explicit material

The random effects analysis of the 31 included studies yielded a mean prevalence of 20.3% (CI: 17.1–23.4). Figure 2 illustrates the meta-analytic forest plot. No outliers were detected. Egger's test ($p < .001$) and inspection of the funnel plot suggested the presence of publication bias (Supplemental Figure 1). Significant heterogeneity of effect sizes was present ($Q = 1,659.01$; $p < .0001$; $I^2 = 98.19$). Thus, age, gender, and year of data collection were explored as moderators. A meta-regression analysis revealed that the prevalence of online exposure was highest in the year 2000 and decreased in a linear fashion over time ($b = -.014$; $p < .05$). Neither age ($b = .033$; $p < .10$), nor gender ($b = .020$; $p < .08$) explained between-study differences in the prevalence of unwanted online exposure of sexually explicit material. In this meta-analysis, we also compared the prevalence of studies conducted in North America (k [# of estimate] = 4, 26.5%, CI: 22.4–30.6), with studies from various regions of Europe (Eastern Europe: $k = 5$, 18.5%, CI: 13.2–23.8; Northern Europe: $k = 10$, 22.4%, CI: 16.4–28.5; Southern Europe: $k = 4$, 19.0%, CI: 8.1–29.8; Western Europe: $k = 6$, 17.5%, CI: 9.6–25.3); no significant geographical differences emerged.

Meta-analysis of prevalence of unwanted online sexual solicitation

The meta-analysis of nine studies revealed a mean prevalence rate of 11.5% (CI: 9.4–13.6). Figure 3 illustrates the meta-analytic forest plot. No outliers were detected. Egger's test ($p < .001$) and inspection of the funnel plot suggested the presence of publication bias (Supplemental Figure 2). Significant heterogeneity of effect sizes was present when all studies were included ($Q = 371.3$; $p <$

$.0001$; $I^2 = 95.9$), thus moderator analyses were explored. A meta-regression analysis revealed that the prevalence of online exposure has decreased over time ($b = -.010$; $p < .01$). Gender explained between-study heterogeneity, with prevalence of online solicitation increasing as the percentage of males increased ($b = .010$; $p < .001$). Age did not significantly moderate the prevalence of unwanted online solicitation ($b = .020$; $p < .0001$). In this meta-analysis, we also compared the prevalence of the six studies from North America (11.8%, CI: 8.4–15.2) with the two from Europe (11.4%, CI: 8.4–15.2), and the prevalence of unwanted online sexual solicitation across these continents was equivalent.

Discussion

The Internet is arguably one of the most impressive technological advancements of our time. Use of the Internet among youth in the developed world is near universal (9.5 out of 10 adolescents use the Internet), and for many, it serves as an invaluable tool to work, play, learn, and communicate [51]. Unfortunately, the Internet can also pose threats to youth in the form of online sexual solicitations and unwanted exposure to sexual content online. The current set of meta-analyses sought to provide an empirical synthesis of these negative online experiences. Findings suggest that youth are at considerable risk of unwanted online sexual exposure and solicitation: approximately one in five youth were exposed to unwanted sexual content, and one in nine experienced unwanted online sexual solicitations. Notwithstanding, it is important to reiterate that these online experiences are potentially consequential events, with 25% of youth reporting that they find these experiences extremely distressing or frightening [10].

The estimates derived herein are similar to the prevalence of other types of youth victimizations, such as sexual (12.7%) [52], emotional (26.7%) [53], and physical (17.7%) abuse [54] as well as the forwarding of sexually explicit images or videos (i.e., sexts) without consent of the initial sender (12%) [55]. While several seminal epidemiological studies [19,38] have highlighted the potential risks of Internet use for youth, this meta-analysis provides empirical confirmation of the degree of the problem. An important caveat prior to further discussion of these findings is that unwanted solicitations can occur in many contexts, and arguably are more common offline versus online [56]. Moreover, many youth reporting online victimizations such as sexual solicitations and harassment also report experiencing offline victimizations in the same time period [56,57]. In the current study, we target the Internet as one context for unwanted exposure and solicitation; however, parents, educators, policy makers, and professionals working with children and families should bear in mind that sexual solicitations can occur anywhere in a child's environment, including in schools, on the street, on the phone, on public transportation, as well as via the Internet. Thus, the current study should be considered in the broader context of victimizations that youth may suffer [56].

The prevalence of unwanted online exposure to sexually explicit material has decreased over time. This decrease may be surprising given the simultaneous increase in young people's access to, and use of, the Internet, particularly via mobile devices. However, this reduction corresponds to the overall declining trends of other risky behaviors among youth, such as teen pregnancy [58] and violent offending [59], in addition to the decline of child sexual abuse [60,61]. Effective Internet safety education programs have provided youth, as well as their parents, with greater awareness of Internet risks and prevention measures [11]. Industry

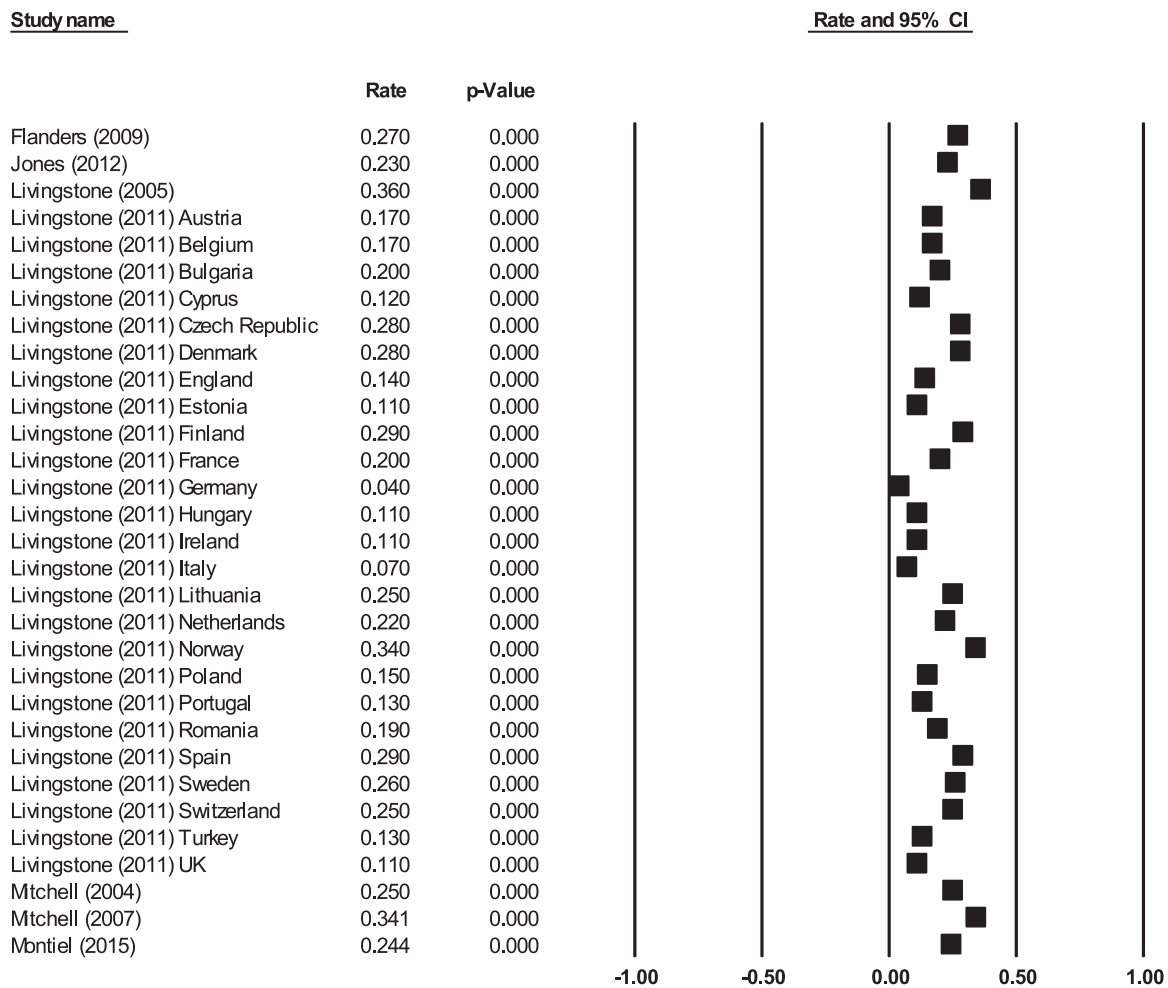


Figure 2. Forest plot of the effect sizes for each study included in the meta-analysis on the prevalence of unwanted online exposure to sexually explicit material.

controls and increased use of spamware and other safety filters have also helped to decrease exposure to unwanted material [62]. Moreover, the introduction of new legislation in many jurisdictions to more effectively investigate and prosecute Internet-facilitated sex crimes may increasingly serve as a deterrent [63].

Gender differences in rates of child sexual victimization are asymmetrical, with females more likely than males to report having endured child sexual abuse [48,53]. In the current meta-analysis, we found that effect sizes for unwanted online solicitation also varied as a function of gender, but in contrast to child sexual victimization, we found that males were at greater risk of experiencing unwanted online sexual solicitations compared to females. While important to interpret cautiously given the small sample size in this analysis, gender-based differences in prevalence may, in part, be a function of the nature of the sites visited by boys, compared to girls, and associated risks. This is consistent with recent public health campaigns that have focused on providing strategies

for male youth to avoid sextortion (i.e., threats to send nude photos unless payment or additional photos are provided) [64]. However, findings herein do not suggest that females are not at risk of experiencing unwanted online sexual solicitations; thus, educational campaigns should also be targeted toward youth of all genders, with a focus on strategies for how to respond to unwanted requests to talk about or do something sexual when solicited online.

Compared to younger adolescents, older adolescents have increased use of, and unmonitored access to, the Internet [21–24]. Thus, we expected that as adolescents age, unwanted online exposure and solicitation would increase. Contrary to expectations, age did not moderate effect size. It is possible that older adolescents are actively seeking out sexually explicit material, thus exposure to the material is not “unwanted” or “unsolicited” [28]. Another possibility is that the age range (12.0–16.5) of available studies for this meta-analysis was too narrow. This represents a limitation of

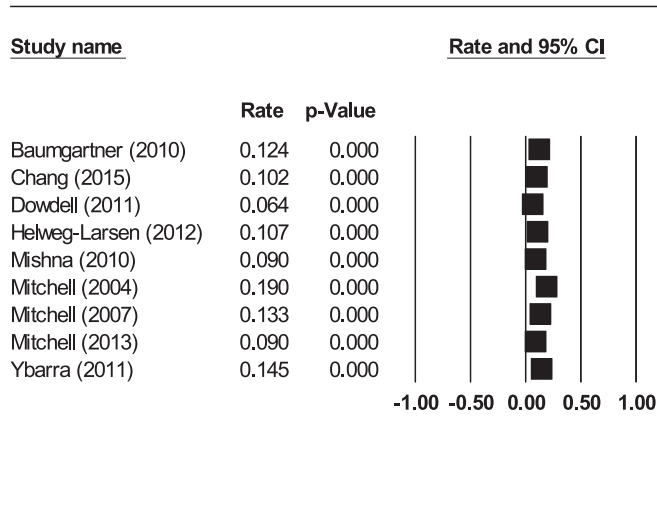


Figure 3. Forest plot of the effect sizes for each study included in the meta-analysis on the prevalence of unwanted online solicitation.

the current meta-analysis, but also of existing studies on this topic more generally. In line with this idea, it is important to point out that one of the fastest growing groups of Internet users are children between the ages of 6 and 10 years [38]; however, prevalence of online exposure and solicitation for this demographic are, to our knowledge, currently unknown. Thus, a critical area of future research is on the benefits and risks of Internet use in this age group. Young children have less well developed cognitive and problem solving skills compared to adolescents [7–9], and they have less sexual knowledge than older adolescents, creating a double naïveté that may place them at greater risk of unwanted online exposure and solicitation [5]. It is possible that with increasing use, children will experience greater susceptibility to online risks [4]. The limited research on this age group (i.e., <10 years) thus far suggests that, while young children may have the theoretical (or hypothetical) knowledge of Internet risks, they may fail to, or inconsistently apply, this knowledge in practice, making them particularly vulnerable to online victimization [5].

Clinical implications

Youth access social media Web sites to foster and maintain social connections. Along with these positive aspects of Internet use, however, come safety risks, particularly for vulnerable adolescents who have experienced maltreatment [10], have deficits in problem solving, communication and social skills, or who are experiencing mental health difficulties [57]. That said, while those who experience challenges offline are known to be at greater risk of experiencing online victimization [56], almost half of those victimized online are not considered high risk [19]. This underscores the importance of both universal and targeted prevention and intervention initiatives that are developmentally sensitive, culturally responsive, and skills based.

To mitigate against unwanted online sexual exposure and solicitation, parents, educators, and healthcare providers should focus on the provision of effective safety strategies that extend beyond descriptive information about Internet technologies, and instead incorporate preventative interventions that teach about healthy relationships (online and offline) [56]. This includes the need to

educate youth about the link between online solicitation and Internet-facilitated sexual assault (i.e., meeting in person and being assaulted by someone they met online) [65], as well as off-line victimizations of a sexual nature. In regard to online risk in particular, researchers have also strongly advocated for greater educational interventions that increase knowledge of grooming behaviors (i.e., ranging from flattery to threats of harming loved ones) designed to enlist adolescents to engage in sexually explicit discussions and interactions online [66,67]. Internet safety messages should target youth rather than just parents since those at greatest risk for unwanted online sexual exposure and solicitation may be in conflict with their families [4,68], may be experiencing intrafamilial abuse, and/or may be hesitant to disclose online behaviors due to fears of reprisals [69]. Consequently, prevention and intervention efforts should inoculate youth against online sexual exposure and solicitation by arming them with accurate and developmentally appropriate information about what constitutes healthy relationships, promoting social skills to foster strong interconnections with peers, and building self-esteem and capacity to refuse solicitations online [70,71]. Emphasizing healthy peer relationships is particularly pertinent given the findings that many online solicitations are perpetrated by peers [72,73].

Supportive adults, including both professionals and parents, must continuously acquire and augment their knowledge with up-to-date information on Internet technologies and online safety. Resources from reliable agencies who specialize in this field can be found online to help guide parents and professionals in this area [74,75]. Preventative software such as filtering, blocking, or monitoring on home computers has been shown to decrease exposure to unwanted online sexual material [76]. However, research suggests that filtering software may only be effective in reducing the risk of unwanted online sexual exposure and solicitation when it occurs in the context of parental monitoring and supervision, and healthy communication between parents and children [56]. Psychoeducational material for parents must also provide information on how to support disclosures by recognizing the profound sense of shame, embarrassment, and self-blame that young people may be experiencing. Furthermore, it is important for parents and professionals to know when and how to intervene if unwanted online exposure or solicitation has already transpired. Internet related sex crimes should be reported to law enforcement and/or child protection services, and, if clinically indicated, evidence-based treatments, such as trauma-informed cognitive behavioral therapy [77] should be considered. Perhaps most importantly, more effective surveillance measures and tougher legal repercussions for those initiating unwanted sexual encounters with youth may help to deter offenders and ensure that declining trends continue.

Limitations

Several important study limitations should be noted. First, unwanted online exposure and solicitation are often assessed using single-item questions that do not differentiate prevalence according to the type of exposure (e.g., pictures and/or videos) and/or method of solicitation (e.g., direct messages and chat rooms). Thus, while this meta-analysis sheds light on the rate at which youth experience unwanted online exposure and solicitation, future research should identify *how* these online encounters of exposure and solicitation occur. Second, there is a critical need for the application of clearly operationalized definitions that better account for the nature and method of online exposure and solicitation. This point is underscored when one considers how

descriptors such as “accidental exposure” or “unwanted exposure” may be interpreted differently by youth. It is possible, for example, that when searching online, a youth may “accidentally” discover sexual images online and find them interesting. Third, our comprehensive literature search spanned from 1990 to early 2016. While a recent paper discussed the prevalence of online solicitation and exposure, the most recent date of data collection was 2011 [19]. Thus, the current findings may not accurately represent youth’s present day online experiences, which are evolving at a rapid pace. Future research is urgently needed to describe present day Internet experiences amongst youth. Fourth, studies of unwanted online exposure and solicitation rely on youth disclosing that these experiences have occurred. Some youth may underreport due to shame, self-blame, or fear of consequences; reactions commonly associated with reluctance to disclose sexual victimization [78]. Thus, it is possible that the mean prevalence reported herein underestimates young people’s Internet experiences. Finally, the age of the solicitor (i.e., peer or adult) was only available in two studies, and thus could not be examined due to insufficient data at the moderator level. Future research on youth experiences with the Internet should explicitly include questions that can distinguish between online risks perpetrated by peers versus adults.

The emotional and physical safety risks associated with the drastic increase of Internet usage among youth have garnered significant attention in the literature across disciplines. Emerging knowledge has helped to better define the problem, systematically document its occurrence, and establish effective prevention strategies. The current meta-analysis has expanded this knowledge base by synthesizing the scope of the problem as reported across discrepant studies. Despite a declining trend that offers hope, this study confirms that the extent of risk is present for a proportion of youth, with one in five and one in nine youth experiencing unwanted online exposure and solicitation, respectively. Gaps identified in this review point to the need for further research on the adverse short- and long-term socioemotional impact of unwanted exposure and Internet-facilitated sex crimes on youth, as well as effective clinical treatments that are sensitive to the unique dynamics associated with online victimization. As Internet access and exposure continues to rise, evidence-informed policies and best practices will be critical for safeguarding vulnerable youth.

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Supplementary materials

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