Title: Health-Related Internet Use by Children and Adolescents: A Systematic Literature Review

Abstract

**Background:** The Internet is widely used among children and adolescents, who have shown a high level of competency with technology. Thus, the Internet has become a great source for supporting youth in their self-care and health-related services. However, few studies have explored adolescents’ Internet use in related to health.

**Objective:** The purpose of this systematic literature review is to examine the phenomenon of children and adolescents’ health-related Internet use and to identify the gaps in research.

**Methods:** Thirteen studies were selected from a search in major electronic databases: PubMed, CINAHL, and PsycINFO. The search terms consisted of “health-related Internet use,” “eHealth,” “Internet use for health-related purpose,” “Web-based resource,” and “online resource” combined with “child,” “adolescent,” “student,” “youth,” and “teen.” The specific ages of children and adolescents were limited to 24-years old and under.

**Results:** The patterns of the adolescents’ health-related Internet use are identified. The participants of the studies include youth seeking preventing healthcare and youth experiencing a wide range of medical issues. Quantitative studies reported rates of Internet use and Internet access among youth and associated factors were identified. Qualitative studies explored the purpose of health-related Internet use and adolescents’ patterns of health-related Internet use. A major purpose of health-related Internet use is to gain information, and there is inconsistency in adolescents’ perceptions of health-related Internet use.

**Conclusions:** This study provides an important understanding of how youth seek information on the Internet and related support systems for their health care. This review also identifies the
conceptual and methodological limitation of the identified studies and gaps within the studies for future research. This review suggests important features for potential Web-based health interventions for children and adolescents.

**Keywords**

Internet; Children; Adolescent; Health-Related Internet Use; eHealth; Health information
The Internet is widely used among children and adolescents as they have shown a high level of competency with technology [1,2]. With unique features and great benefits, such as highly engaging and motivating virtual components, portable size, multi-tasking tools with easy and fast access to computers and mobile devices, the Internet has become prevalent mode of communication and networking among youth [3,4]. Adolescents engage in different activities online, such as information searching, sharing personal information and artifacts, social media use, recreational activities, etc [5]. As youth have higher level of access to the Internet in their daily life [6], it has become a great resource for them in supporting their self-care and health-related services [7-9]. Although the Internet is widely accessible and is greatly acceptable by youth, there has been a limited understanding of the patterns and characteristics of youth health-related Internet use.

Youth have unique characteristics and health challenges for health promotion. During adolescence, youth undergo various biological developments that involve physical, emotional, and social along with pubertal maturation [10,11]. Because of these unique developmental characteristics, adolescence is also considered the most vulnerable period for engagement in various risky behaviors, such as smoking, drugs, and sex [10]. At the same time, they tend to form healthy habits and learn appropriate practices for their health issues, which could last for rest of their lives [12]. Thus, youth is a critical period for their health and they need specific guidance for information and support related to their health and developmental milestones [13].

The Internet has potential benefits for adolescent health promotion including increasing the number of interventions for diverse topics in the use of Internet among youth [14,15]. However, there have been a limited understanding of health-related Internet use with youth. The purpose of this review includes systematical analysis of the current research in the recent 10
years in which health-related Internet use has been studied, as well as includes suggestions for important features that need to be considered for more effective Web-based health interventions for children and adolescents. The specific aims of this systematic review are (1) describe the phenomenon of children and adolescents’ health-related Internet use, (2) identify benefits and barriers to health-related Internet use for children and adolescents, and (3) examine conceptual and methodological issues of the current literature.

**Methods**

The Preferred Reporting Items for Systematic Reviews and Meta Analysis provided a guideline for this systematic review study [16]. Based on the purpose of the study, inclusion and exclusion criteria are set and the search process is described in Figure 1.

**Search Strategy**

Studies were selected from a search in major electronic databases: PubMed, the Cumulative Index of Nursing and Allied Health Literature (CINAHL), and PsycINFO. Additional search was conducted using the Google Scholar. Search terms consisted of “health-related Internet use,” “eHealth,” “Internet use for health-related purpose,” “Web-based resource,” and “online resource,” combined with “child,” “adolescent,” “student,” “youth,” and “teen.” The specific ages of children and adolescents were limited to 24 years old and under. Initial search was conducted from September 2015 to June 2016.

**Eligibility Criteria**

Studies were included if:

(1) they were published in a peer-reviewed academic journal in the past 10 years;
(2) age of the adolescents were limited to younger than 24 years old;
(3) the studies examined general Internet use seeking healthcare services, resources, or information or use Internet for their health promotion and self-care
(4) they were written in English or Korean.
Studies were excluded if:

1. the study participants were mixed with other age population aged 24 or older;
2. age of participants were not specified or reported;
3. the study participants were trained to be professional healthcare providers (i.e. physicians, nurses, or medical or nursing students);
4. the intervention modality was combined with other non-Web-based technologies (i.e. telephone);
5. Internet was used as a modality for survey, recruitment, searching for relevant literature without the aiming to study participants’ health-related Internet use;
6. studies only focused on quality assurance of specific Websites;
7. they were grey literature including dissertation, conference proceeding paper or abstract, or editorials; and
8. they were focusing on testing a specific Internet-based intervention.

Data Extraction, Analysis, and Synthesis

An author initially reviewed titles and abstracts based on the purpose of the study and the inclusion criteria. Two reviewers independently reviewed the full articles that were initially selected and coded them into an analysis table. The coding scheme was developed to present the components of the study design and the findings in order to better answer the first two research questions. For the third research question, a coding table was created based on the gridlines of Agency for Healthcare Research and Quality criteria [16,17]. After coding tables were completed, the authors checked discrepancy of coded results to ensure accuracy and analyzed the findings based on Eysenbach’s framework [18]. In the case of disagreement, external review was considered.

Figure 1. Flow chart of the literature search process
Results

Characteristics of Study Participants

Thirteen studies met the inclusion criteria and, of these, most studies ($n = 6$) were conducted in the United States. Studies were also conducted in the United Kingdom ($n = 3$), and Canada, Nigeria, and Sweden ($n = 1$, each). In the selected studies, majority of the adolescent did
not have any pertinent medical conditions \((n = 9)\), and those with were identified as juvenile arthritis, type 1 diabetes mellitus, and undergoing orthodontic treatment. Apart from one study whose sample distinctly consisted of adolescent girls, all studies had mixed gender, although the majority of the 12 studies \((n = 9, 75\%)\) had mostly female participants.

The selected studies had limitations in representing diverse populations of adolescents including gender, race and ethnicity, socioeconomic status, and the regional status. A high proportion of racial and ethnic minorities were found in five studies; Hispanic were the largest group in these studies, with proportions ranging from 9\% to 84\% [19,20].

Community type of the study participants, also indicative of their socioeconomic status, varied from living in predominantly underserved, minority community areas [21] to middle class income areas as well as in urban areas. A summary of the study setting, study participants, and their characteristics, are shown in Table 1. One study included participants in a juvenile detention facility to identify the characteristics of subgroups of youth [21].

Total number of participants, including all selected studies, was 2,822. Number of participants included in the study ranged from as low as 24 to 1,145. Age range of selected participants were 24 year or younger. One study with three participants above 24 years old was included due to its eligibility of the participants in the study as college students [22].
<table>
<thead>
<tr>
<th>First author, Year</th>
<th>Country</th>
<th>Number of Participants</th>
<th>Characteristics of Adolescents</th>
<th>Age</th>
<th>Demographics</th>
<th>Medical conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johnson et al., 2015 [30]</td>
<td>USA</td>
<td>134</td>
<td>Mostly female (83.6%), Caucasian (81.3%), living with two parents in an urban location</td>
<td>14-19 yrs</td>
<td>Mostly female (83.6%), Caucasian (81.3%), living with two parents in an urban location</td>
<td>Juvenile arthritis</td>
</tr>
<tr>
<td>Robb et al., 2014 [22]</td>
<td>USA</td>
<td>59</td>
<td>Mostly female (80%), Caucasian non-Hispanic (85%), UG college students who had completed an introductory health and wellness course</td>
<td>18-24 yrs</td>
<td>Mostly female (80%), Caucasian non-Hispanic (85%), UG college students who had completed an introductory health and wellness course</td>
<td>None</td>
</tr>
<tr>
<td>Wetterlin et al., 2014 [20]</td>
<td>Canada</td>
<td>521</td>
<td>Mostly female (76.6%), East/Southeast Asian (44%) or European/Caucasian (35.5%), living in British Columbia (86%) and currently in school (87.3%)</td>
<td>17-24 yrs</td>
<td>Mostly female (76.6%), East/Southeast Asian (44%) or European/Caucasian (35.5%), living in British Columbia (86%) and currently in school (87.3%)</td>
<td>None</td>
</tr>
<tr>
<td>Fergie et al., 2013 [31]</td>
<td>UK</td>
<td>34</td>
<td>Mostly female (70.6%), school pupils or university students, living in an urban area</td>
<td>14-18 yrs</td>
<td>Mostly female (70.6%), school pupils or university students, living in an urban area</td>
<td>None</td>
</tr>
<tr>
<td>Henderson et al., 2013 [23]</td>
<td>UK</td>
<td>105</td>
<td>Male (58%) and female (42%), most who have experienced some form of pain in last three mos (80%)</td>
<td>11-18 yrs</td>
<td>Male (58%) and female (42%), most who have experienced some form of pain in last three mos (80%)</td>
<td>None</td>
</tr>
<tr>
<td>Nordfeldt et al., 2013 [24]</td>
<td>Sweden</td>
<td>24</td>
<td>Male (54%) and female (46%), living in catchment area of a county hospital in the South-East of Sweden, either in compulsory or secondary school, all had Internet access at home</td>
<td>10-17 yrs</td>
<td>Male (54%) and female (46%), living in catchment area of a county hospital in the South-East of Sweden, either in compulsory or secondary school, all had Internet access at home</td>
<td>Type 1 DM</td>
</tr>
<tr>
<td>Stephens et al., 2013 [25]</td>
<td>UK</td>
<td>15 (interview) + 50 (survey)</td>
<td>Majority use SNS (76%)</td>
<td>10-16 yrs</td>
<td>Majority use SNS (76%)</td>
<td>Undergoing orthodontic treatment</td>
</tr>
<tr>
<td>Gaskin et al., 2012 [21]</td>
<td>USA</td>
<td>79</td>
<td>Mostly male (84%), Hispanic (70%), youth detained in a juvenile detention facility, predominantly underserved, minority communities, high level of access to Internet,</td>
<td>13-18 yrs</td>
<td>Mostly male (84%), Hispanic (70%), youth detained in a juvenile detention facility, predominantly underserved, minority communities, high level of access to Internet,</td>
<td>None</td>
</tr>
<tr>
<td>Ghaddar et al., 2012 [28]</td>
<td>USA</td>
<td>261</td>
<td>Mostly female (60%), Hispanic (84%), HS students</td>
<td>14-20 yrs</td>
<td>Mostly female (60%), Hispanic (84%), HS students</td>
<td>None</td>
</tr>
<tr>
<td>Selkie et al., 2011 [27]</td>
<td>USA</td>
<td>29</td>
<td>Mostly female (65.5%); heterosexual (61%); Sexual experience (58.6%)</td>
<td>14-19 yrs</td>
<td>Mostly female (65.5%); heterosexual (61%); Sexual experience (58.6%)</td>
<td>None</td>
</tr>
<tr>
<td>Buhi et al., 2009 [29]</td>
<td>USA</td>
<td>34</td>
<td>Mostly female (67.6%), 1st yr UG students, Caucasian, reported as experienced Internet users</td>
<td>18-19 yrs</td>
<td>Mostly female (67.6%), 1st yr UG students, Caucasian, reported as experienced Internet users</td>
<td>None</td>
</tr>
<tr>
<td>Tercyak et al., 2009 [19]</td>
<td>USA</td>
<td>332</td>
<td>Mostly female (70%), AA (44%) or Caucasian (39%), lived in predominantly middle class income areas</td>
<td>11-12 yrs</td>
<td>Mostly female (70%), AA (44%) or Caucasian (39%), lived in predominantly middle class income areas</td>
<td>None</td>
</tr>
<tr>
<td>Nwagwu, 2007 [26]</td>
<td>Nigeria</td>
<td>1,145</td>
<td>All female, currently in-school or dropped-out-of-school, living in an urban area</td>
<td>13-19 yrs</td>
<td>All female, currently in-school or dropped-out-of-school, living in an urban area</td>
<td>None</td>
</tr>
</tbody>
</table>

Abbreviation: AA, African American; DM, diabetes mellitus; HS, high school; Mos, months; SNS, social networking sites; UG, undergraduate; UK, United Kingdom; USA, United States of America; Yrs, years.

* The study states that they included both enlightenment and affluence.
Health Related Internet Use (Table 2)

Prevalence of General Internet Use and Patterns of Health-Related Internet Use

The study reported that youth spend a large amount of time using the Internet. According to the studies, 82.8% of youth (11-18 years old) spend 1 to 4 hours/day [23], while 63% of undergraduate college students go online more than 2 hours/day, and 25% of them spent 1 or 2 hours/day while 12% of youth spend less than 1 hour/day [22]. Interestingly, 10-11 years old boys reported using the Internet only 30 minutes/day, whereas 14-15 years old youth spend several hours/day [24]. However, during 16-17 years old age range, the amount of time spent online becomes less than 1 hour/day [24] most likely related to higher burden of academic work.

The high frequency of the Internet use is also reported, and this finding is consistent across the studied countries. Sixty-four percent of youth (10-16 years old) in the UK are daily users, and 26% use the Internet once or twice a week [25]. Ninety-seven percent of youth use the Internet at least once a month, and 87% of them use it at least once a week in the USA [21]. As a contrast, in Nigeria, 73% of youth reported that they have ever used the Internet [26]. For social networking, 96.6% maintain a personal SNS profile, which includes Facebook, My Space, My Yearbook, Tagged and Bebo [27].

According to studies, a high percentage of youth have used the Internet for health-related purpose [28-30]. Eighty-one percent of youth reported that they had checked health information online, and 71% are very likely to search the Internet for information on health; 59% sought health information for family’s health online [28]; and 56% of youth had heard of Medline Plus [28]. Moreover, 65% of youth reported that the Internet is the primary source for health-related information [29]. However, this number is inconsistent among populations depending on specific conditions. Although 91.9% of youth with juvenile arthritis used the Internet for more than 5
minutes/day, 69.4% used 30 minutes/day, and 36.6% used more than 1 hour/day respectively [30], among youth with orthodontic treatment, only 8% of youth used the Internet for the specific disease-related information, and 3% had seen a phone application about orthodontics [25]. In this study, youth in the UK reported that the main source of information is healthcare providers and only 8% of youth use the Internet as a primary source of information [25].

**Purpose of Health-Related Internet Use**

The purpose for the health-related Internet use includes information seeking [21, 25, 27-29, 31], decision making [22], and seeking support by others [31]. The primary purpose for health-related Internet use is seeking information. The topics that youth seek online includes information on daily health-related issues, physical, mental, and social problems [20, 30]. Daily issues, such as sports injuries, flu, chronic diseases, asthma, sexual health, fitness, and infections, are common interest by youth on the Internet [23]. This is consistent with youth who have diseases [30]. According to Johnson colleagues’ study [30], youth are more likely to use the Internet for less sensitive topics, such as nutrition and exercise, and less likely for the sensitive topics, such as violence, sexual health, bullying, tobacco, alcohol, drugs and mental health. In addition, when youth who are undergoing certain symptoms, such as emotional difficulties, often seek help for their feelings [20] and information related to their psychosocial health from peers online [31]. Interestingly, it is reported that youth do not tend to use the Internet for pain management [23]. Among youth with certain diseases, such as arthritis, DM, youth also seek information related to their symptoms (52.4%) and treatment options (47.4%) [20]. Interestingly, youth tend to use other alternative sources (healthcare providers or youth) depending on the topic.
Also, youth use the Internet to connect and create supportive communities on particular health issues. Youth expressed interests in diverse online activities related to health including messaging others, networking, and receiving information. Intriguingly, youth group (61.2%) preferred online support group to offline in-person groups [30]. Children in hospitals expressed strong interests in the Internet use for support networking [24]. Even youth who have a chronic disease such as DM, frequently used the Internet for networking purposes as well as for interpersonal contacts with non-diabetic peers [24].

**Associated Factors of Health Related Internet Use**

Gender, age, and in-school status are associated factors for frequency of health-related Internet use [23,24]. Girls tend to use the Internet more often for help seeking online [23]. Youth aged 16-17 year old reported that the Internet is the primary source for information while youth who are aged 10-11 years old regarded their parents as the main source for information [24]. Also, youth who are in-school are more capable in finding information online than out-of-school youth [26]. There was no association related to the race and ethnicity [21].

Notably, the characteristics of youth’ emotional and engagement in risk behaviors are associated with the Internet use [30]. Youth who have lower psychosocial quality of life tended to have higher use of the Internet related to their health [30]. No association related to coping skills or pain frequency is reported for health-related Internet use [23]. Also, youth who have high risk behaviors, such as smoking, less physical activity and sun-protection activity, and depression, are more willingly to use technology for health promotion [19].

E-Health literacy level was positively associated with the seeking health information online [28]. Also, exposure to a health course, online information seeking, exposure to MedlinePlus, parents’ need for interpreter in communication with healthcare providers, upper
grade, financial status higher health-related self-efficacy, ethnicity (non-Hispanic) are associated with higher level of e-health literacy [28]. Regarding e-Health literacy, youth who think the Internet as useful tended to have higher e-Health literacy level [22]. An exposure to a specific Website such as Medline online is known as a facilitator for health related Internet use. According to Ghaddar and colleagues’ study [28], youth who enrolled on campuses promoting careers in the healthcare field, and exposure to a health course are more likely to have heard of Medline Plus. Also, 11th grades are more likely to use Medline Plus than 9th or 10th graders [28]. Also, youth whose parents need interpreters for communication between a family members and a healthcare provider are more likely to have heard of Medline Plus [28]. No association between access to technology and willingness for eHealth literacy engagement is found [19].

**Youth Perceptions of HRIU**

**Perceived Benefits**

Regarding perceived importance and usefulness of the Internet, it is reported that 75% of youth responded that having an access to health-related resources on the Web is important [22]; whereas 17% are unsure and 9% do not think that it is of importance. Seventy-eight percent responded that it is useful for health-related decision-making [22] while 17% are not sure, and 5% do not think that the Internet is useful for health-related purpose. When youth are asked specifically about the sexual health-related use, 48.1% of youth reported that they are relieved or comforted by the information online [29]. Also, this positive perception is consistent with the study conducted for youth who have been detained in a juvenile detention facility where 90% of youth believed that the access to information on Website is useful [21].

User-generated content is perceived as advantageous of online health content as this information provides diverse views from experiential knowledge with anonymity [31].
**Perceived Barriers**

Eighty-two percent (82.9%) of youth reported the likeliness of using an information-based Website when undergoing difficult time in life [20]. Seventy-seven percent of youth reported that they are not likely to use social media Websites for information or help-seeking purposes during difficult time [20]. Only 10.9% accessed the recommended health-related Websites by experts and 10.6% used social media for help seeking for problems such as anxiety or depression (10.6%) [20].

Online privacy is a key issue with which youth are concerned [24] as 87.7% rated the importance of online privacy [20]. It is particularly an important issue for people who have a specific health problem, such as mental health issues [20]. Although there are different perceptions in subgroups, among youth who are detained in a juvenile detention facility, 85% expressed that they are not concerned about the privacy of their health information online on the password-protected sites [21].

Another strong concern among youth who use the Internet is the accuracy of the information [31]. When youth are asked specifically about the sexual health related use, 44.4% of youth reported that they are confused by the information they find [29] 25.9% of youth are frustrated by lack of information or inability to find information needed. Also, 18.5% are overwhelmed by the amount of information [29]. Remarkably, finding local information is more difficult than finding general information online [27,29].

**Important Features for Usability and Current Practice**

Adolescents noted that they use different strategies to evaluate factual information and user-generated opinions on social media Websites [31]. They expressed the importance of the initial impression of the Website [24], as to whether it posed a serious and trustworthy
impression to them. Also, as they value integrity and anonymity, they are cautious about sharing their personal information [24]. Also, youth expressed that updating new value, such as current and recent events, facts (e.g., verifiable information) and eye-catching design to the sites are important although 51.9% said they never or hardly ever check the last updated dates or reviewed by a medical professional [29]. Also, plainness (i.e., clear content and layout) is another important features that youth prefer [24]. In addition, youth prefer open access sites that do not require logins [24]. Regarding content, youth want more information related to medications (92%), immunizations (90%), and sexually transmitted infections testing results (80%) [21].

These findings are consistent with a specific topical health (e.g., sexual health) [27,29]. Regarding the Internet use related to sexual health, youth want sexual health education sites to be easily accessible, understandable, and user-friendly [27]. Also, they want resources to be trustworthy-credible, confidential and offered in a nonthreatening way [27]. Additionally, youth want more information on specific information and in-person resources such as local clinic resources as it seem to be the most challenging information to find [27,29].

When youth search sexual health-related information, youth use Google, Yahoo, and Ask.com most often as the first search engines [27,29]. They tend to follow sponsored link and followed first 3 search results. Also, Wikipedia is the source of most credible sexual health information [29].
<table>
<thead>
<tr>
<th>First author, Year</th>
<th>General Internet Use</th>
<th>Health-Related Internet Use</th>
<th>Purpose</th>
<th>Characteristics (Associated Factors, Perceptions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johnsson et al., 2015 [30]</td>
<td>-</td>
<td>-</td>
<td>Information on exercise (87.3%), nutrition (83.6%), other health topics not r/t arthritis (70.1%), mental health issues (50.7%), puberty (43.2%), sexual health (42.5%), drug use (27.6%), bullying (23.9%), and tobacco use (20.1%)</td>
<td>-</td>
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<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Instant messaging or chatting with same disease (85.0%)</td>
<td>Facilitator: low psychosocial quality of life</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Online forum (94.0%)</td>
<td>-</td>
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<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Building personal profiles and networking (87.3%)</td>
<td>-</td>
</tr>
<tr>
<td>Robb et al., 2014 [22]</td>
<td>63%=greater than 2 hrs/d</td>
<td>-</td>
<td>Information</td>
<td>75%=access to health resources on the Internet is important</td>
</tr>
<tr>
<td>-</td>
<td>25%=1-2 hrs/d</td>
<td>-</td>
<td>Decision making</td>
<td>78%=Internet is useful for health-related decision making</td>
</tr>
<tr>
<td>-</td>
<td>12%=less than 1 hr/d</td>
<td>-</td>
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<td>-</td>
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<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wetterlin et al., 2014 [20]</td>
<td>-</td>
<td>-</td>
<td>Information (symptoms (52.4%), treatment options (47.4%), Web-based questionnaires or assessment tests (23.8%), prevalence rates (17.3%), peer support (13.1%), and other (2.5%))</td>
<td>Likelihood of visiting Web-based resources during a difficult time in life: 82.9%=information-based Website with mainly text, 76.8%=social media Websites</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Seeking help for their feeling</td>
<td>Likelihood of contacting human within a Web-based mental health resource: 83.9%=online professional (e.g., therapist or coach)</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>87.7%=reported that online privacy is very important</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10.9%=accessed to the recommended Websites</td>
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<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>10.6%=used social media (e.g., Facebook, MySpace) for help seeking with problems such as anxiety or depression</td>
</tr>
<tr>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Important features: description of interventions and treatments, evidence-based</td>
<td>-</td>
</tr>
</tbody>
</table>
Conceptual and Methodological Evaluations (Table 3 & 4)

Conceptualization

The key concepts for health related Internet use in the studies include eHealth literacy, health information seeking behavior, eHealth promotion, eHealth intervention, and eMental Health (Table 3). These concepts are based on the online activities related to information seeking and understanding or communication activities for health issues, problems, and health promotion. E-Health promotion and eHealth intervention provide more nuanced definitions related to Web-based interventions and education.

The conceptual definitions are provided in only a few studies, and of these, only a few used a theoretical framework. In Tercyak and colleagues’ study [19], the frameworks used are theory of planned behavior and problem behavior theory, which explain the basis of the common mechanisms of multiple behavioral problems and provide frameworks that focuses on individuals’ motivation for eHealth promotion associated with their behavior changes. When the media influence is studied, the Uses and Gratifications (U&G) theory [26] is used. This theory assumes that the users choose media as an avenue to actively participate while being goal-directed, rather than as a mere passive recipients. This theory also indicates that the media is a gratification of psychosocial needs. One study used grounded theory [27], with the purpose of theory development.

<table>
<thead>
<tr>
<th>Key concept related to HRIU</th>
<th>Definition and sources</th>
<th>Theoretical Background</th>
<th>Authors and articles</th>
</tr>
</thead>
<tbody>
<tr>
<td>eHealth literacy</td>
<td>“Ability to seek, find, understand, and appraise health information from electronic resources and apply such knowledge to addressing or solving health problems” [33]</td>
<td>-</td>
<td>Robb et al, 2014, p. 1 [22]</td>
</tr>
<tr>
<td>Health information seeking behavior</td>
<td>“Purposive search for health-related information to satisfy”</td>
<td>-</td>
<td>Stephens et al., 2013, p. 303 [25]</td>
</tr>
<tr>
<td>-------------------</td>
<td>-------------------------------------------------------------------</td>
<td>------------------------------------------------</td>
<td>--------------------------------</td>
</tr>
<tr>
<td>eHealth intervention</td>
<td>“Integration of information and communication technology.”</td>
<td>-</td>
<td>Johnson et al., 2015, p. 666 [30]</td>
</tr>
<tr>
<td>eMental Health</td>
<td>“Use of information and communication technologies to improve mental health.” [35]</td>
<td>-</td>
<td>Wetterlin et al., 2014 [20]</td>
</tr>
<tr>
<td>None</td>
<td>Buhi et al., 2009 [29]</td>
<td>Fergie et al., 2013 [31]</td>
<td>Gaskin et al., 2012 [21]</td>
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<tr>
<td></td>
<td>Nwagwu, 2007 [26]</td>
<td>Selkie et al., 2011 [27]</td>
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</tbody>
</table>

**Methodological Evaluation**

**Study Design**

Summary of methodological evaluation is shown in Table 4. All studies are descriptive studies in Table 4 with the majority being cross-sectional studies, while 30.8% (n=4) are correlational studies. In the included studies, 69.2% of the studies (n=9) used quantitative study design, while 23.1 % of the studies (n=3) used qualitative study design, and 15.4% (n=2) used mixed methods or multiple methods in Table 4. Quantitative studies reported rates and the access of the Internet use among youth, and associated factors related to the Internet use are identified. Qualitative studies and mixed methods explored how youth perceived benefits and barriers of health-related Internet use.

**Study Sample**

About half of studies (50%) used convenience sampling technique [19-23,29,30], while the additional half (50%) used purposive sampling strategies [24,25,27,29,31], stratified
sampling technique [28], or random sampling in multiple sites [26]. Most studies used multiple sites for sampling (50%) or used multiple resources, such as both online and offline communities for recruiting. No studies specifically indicated sample size justification.

**Data Collection and Analysis**

Online survey (46.2%) is the most common data collection technique [20,22,23,28-30]. For qualitative studies, focus group method was commonly used. Also, semi-structured interviews were conducted. Most studies used investigators-developed questionnaire to assess health related Internet use. This poses potential issues related to the validity and the reliability of their questionnaire, instead of using the existing instruments. The most common analytic technique used is descriptive, which includes descriptive statistics, univariate analyses (t-test, Chi Square Test), and multivariate analyses (linear regression, logistic regression, ANOVA). No quantitative studies indicated they met the statistical assumptions. Also, how missing data were treated is missing in most studies. For the survey studies, the data are self-reported, which has some bias. Analytic approach was appropriate for the level of data and measurement. For qualitative studies, thematic analysis, content analysis, inductive descriptive analysis were commonly used.

**Table 4. Methodological Evaluation of Study Quality**

<table>
<thead>
<tr>
<th>First Author, Year</th>
<th>Research design</th>
<th>Conceptual framework</th>
<th>Sampling</th>
<th>Data collection method and instrument</th>
<th>Analysis method</th>
<th>Threats to validity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Johnson et al., 2015 [30]</td>
<td>Quantitative; Cross-sectional</td>
<td>None</td>
<td>Convenience sampling in multiple sites (Clinics, advocacy organizations’ Websites, Facebook)</td>
<td>Online survey using MyRheum, Illness Intrusiveness Scale and investigator-developed questionnaire</td>
<td>Descriptive Statistics, T test, Chi-square test</td>
<td>Self-report and self-selection bias; heterogeneous sample</td>
</tr>
<tr>
<td>Robb et al., 2014</td>
<td>Quantitative; Cross-sectional</td>
<td>None</td>
<td>Convenience sampling in a single site</td>
<td>Online survey using eHealth literacy scale</td>
<td>Descriptive statistics; Mann-</td>
<td>Self-report; Limited generalizability</td>
</tr>
<tr>
<td>Study</td>
<td>Design</td>
<td>Sampling Method</td>
<td>Data Collection</td>
<td>Analysis</td>
<td>Limitations</td>
<td></td>
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<tr>
<td>Wetterlin et al., 2014 [20]</td>
<td>Quantitative; Cross-sectional</td>
<td>Convenience sampling in multiple sites (Facebook and Twitter, online university student communities, community organizations)</td>
<td>Online survey using Bell youth Impact Survey and investigator-developed questionnaire</td>
<td>Descriptive statistics and descriptive analysis</td>
<td>Self-report and self-selection bias; Limited generalizability due to single site and small sample size</td>
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<tr>
<td>Fergie et al., 2013 [31]</td>
<td>Qualitative</td>
<td>Purposive and snowball sampling in multiple sites (university course conveners and community youth group leaders)</td>
<td>Focus group analysis</td>
<td>Thematic analysis using a constant comparison method</td>
<td>Self-selection bias; Limited generalizability (homogenous sample)</td>
<td></td>
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<tr>
<td>Henderson et al., 2013 [23]</td>
<td>Quantitative; Cross-sectional; Correlational</td>
<td>Convenience sampling in multiple sites (4 schools)</td>
<td>Online survey using investigator-developed questionnaires, pain coping questionnaire et al.</td>
<td>Descriptive statistics; Chi-square test, Correlational analyses (Pearson r test)</td>
<td>Self-report; Limited generalizability</td>
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<tr>
<td>Nordfeldt et al., 2013 [24]</td>
<td>Qualitative</td>
<td>Purposive sampling (area of a county hospital)</td>
<td>Focus group</td>
<td>Qualitative inductive analysis; content analysis</td>
<td>Self-selection bias; Limited generalizability</td>
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<tr>
<td>Stephens et al., 2013 [25]</td>
<td>Qualitative and quantitative</td>
<td>Purposive sampling in a single site (hospital)</td>
<td>Semi structured interview; Survey using investigator-developed questionnaire</td>
<td>Content analysis (framework approach)</td>
<td>Self-report and self-selection bias; Limited generalizability</td>
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<tr>
<td>Gaskin et al., 2012 [21]</td>
<td>Quantitative; Cross-sectional</td>
<td>Convenience sampling in a single site (juvenile detention facility)</td>
<td>Interview using an investigator-developed questionnaire</td>
<td>Descriptive statistics</td>
<td>Self-report and self-selection bias; Limited generalizability</td>
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<tr>
<td>Researcher(s) and Year</td>
<td>Methodology</td>
<td>Sampling</td>
<td>Data Collection</td>
<td>Data Analysis</td>
<td>Limitations</td>
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<tr>
<td>Ghaddar et al., 2012 [28]</td>
<td>Quantitative; Cross-sectional; Correlational</td>
<td>None</td>
<td>Stratified random sampling in multiple sites (4 school)</td>
<td>Online survey using investigator-developed questionnaires, General Self-Efficacy Scale, eHEALS, Newest Vital Sign</td>
<td>Descriptive statistics, Univariate tests (Chi-square &amp; t tests); multivariate analyses (linear &amp; logistic regressions)</td>
<td>Self-report; Limited generalizability (single state)</td>
</tr>
<tr>
<td>Selkie et al., 2011 [27]</td>
<td>Mixed Methods; Cross-sectional</td>
<td>Grounded theory</td>
<td>Purposive sampling in multiple sites (community centers and schools)</td>
<td>Focus group; paper survey using Youth Risk Behavior Survey, the National Health and Nutrition Examination Survey</td>
<td>Descriptive analysis; Constant comparative method</td>
<td>Self-report and self-selection bias; Limited generalizability</td>
</tr>
<tr>
<td>Buhi et al., 2009 [29]</td>
<td>Quantitative and qualitative; Cross-sectional</td>
<td>None</td>
<td>Convenience and purposive sampling in a single site (college)</td>
<td>Online survey using investigator-developed questionnaires; Observation (verbal report using “talking out loud” method)</td>
<td>Descriptive statistics; descriptive analysis</td>
<td>Self-report; limited generalizability due to single site</td>
</tr>
<tr>
<td>Tercyak et al., 2009 [19]</td>
<td>Quantitative; Correlational</td>
<td>Problem behavior theory; theory of planned behavior</td>
<td>Convenience sampling in a single site (hospital)</td>
<td>Survey; self-report using Adolescent eHealth Promotion Scale (AeHPS), CDC’s youth Risk Behavior Survey, Center for Epidemiologic Studies-Depression Scale (CES-D)</td>
<td>Multivariate linear regression</td>
<td>Self-report and self-selection bias; limited generalizability</td>
</tr>
<tr>
<td>Nwagwu, 2007 [26]</td>
<td>Quantitative; Cross-sectional; Uses and gratifications (U&amp;G) theory</td>
<td>Random sampling in multiple site</td>
<td>Survey; Investigator-modified</td>
<td>Descriptive statistics, Chi-square</td>
<td>Limited generalizability due to</td>
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</tbody>
</table>
Correlational (22 schools and community organizations) questionnaire and t tests; Regression analysis incomparability of proportions of in-school and out-of-school samples

### Discussion

**Summary of Findings and comparison from previous work**

This study deepened our understanding of how youth seek information on the Internet and related support systems for their health care. The large amount of time is spent for Internet use and youth are frequent Internet users; majority spend more than 2 hours/day daily. Although there is inconsistencies regarding the amount of time and frequency of health-related use depending on populations and disease, majority of youth have used Internet for health-related purposes and is the most frequent source of information.

Overall, youth are positive about the Internet use for their health. As the Internet is the most frequently used information source for youth, Internet is commonly used for health-related information for both the healthy and the non-healthy youth. Among healthy youth, this information includes sensitive topics, such as sexual health, violence as well as less sensitive topics, such as exercise and nutrition. The topics they searched also include finding treatment options among youth with certain diagnoses. Also, seeking support and networking are other common purpose for health-related Internet use, which is consistent with other population [32]. It is shown from the study that the youth who have specific disease use the Internet to find friends [24], however this may be related to unique characteristics of youth who are comfortable meeting people online. Also, youth tend to prefer using support groups rather than the in-person meetings and are not particularly bound to people with similar diagnosis. These characteristics are related to the perceived benefits of the Internet use, as some youth consider the use of the
Internet as a space where they can share sensitive information. Also, youth are interested in finding information both from reliable sources, such as healthcare professionals or experts, and user-generated information from peers who may have experienced the same issue. Youth believe that it is helpful to learn diverse views on health topics [24].

Although youth have high prevalence of health-related Internet use, there are several perceived challenges that are reported. In order to have useful Internet-based health interventions or sites available for youth, credible resources and privacy are important factors for successful outcomes. Credibility is evaluated by the youth usually based upon its appearance, frequent citation, and by Website’s domain name such as dot com, dot gov, or dog orgs, but often there is no way to tell [27,29]. Privacy and confidentiality may indicate the lack of social networking site use for online help or support service in mental health [20]. Also, it is reported that youth have experienced challenges finding specific information, such as local resources despite their competency in finding general information. User-friendly feature, such as sites that are do not require log in, are suggested as another important elements to enhance usability. Also, readability and well-organized sites are considered important. Finding the most recently updated sites or checking Website creators are less common practice among youth, and an area where education may be anticipated for youth. It is perceived that there is a lack of useful, reliable resources for particular information they need, such as particular disease-related information or healthcare topics for youth. Sites that can provide reliable information for youths need to be developed.

There are important findings related to characteristics of subgroups for health-related Internet use. Youth whose parents have low health literacy and need interpreters have high usage of the Internet and are likely to seek health information online for their family. Also, youth who are in the juvenile detention facility less worry about privacy issues online and are willing to
share information online. There are different patterns of the Internet use depending on their age. It is generally reported that older youth become more frequent users of the Internet for their health. Youth who have previously taken or received education on Internet use, such as courses to enhance their eHealth literacy level, allows them to be a more competent in their use of the Internet for their health, especially when evaluating Websites, which suggests needs for further health literacy education [33]. No gender difference is reported except for one study that indicated girls tend to be a more frequent Internet users for their health than boys in pain management. In-school education also facilitated youth competency of health-related Internet use. Also, youth who have a high risk with respect to risky behaviors tend to use the Internet more often than youth with lower risk for their health, which indicates needs for developing content for preventing behavioral issues.

**Limitations of this review**

Although this study followed the evidence-based guideline and systematic approach, there could be a chance of error in coding. Also, there is potential for subjectivity in analyzing the findings although two coders carefully reviewed each article and coded them independently and discussed while double-checking each process. Additionally, there may be articles on this topic that may not have been found in the four search engines, even though they are most frequently used search engine in the field. When the authors coded the methodological approaches of each article, the authors try not to assume specific approach if not stated verbatim in the article. For example, when there is no specific approach for sampling mentioned in the article, we coded them as a convenience sampling. This may have caused potential errors regarding what the authors did in their study.

**Implications**
Although this is an emerging field of study, relatively few studies have explored health-related Internet use. Particularly as increasing number of Internet-based interventions are developed and applied for youth population, it is important to understand the characteristics of health-related Internet use among youth. Although Internet is both widely accessed and great acceptability by youth, there was a limited understanding of the patterns and characteristics youth health-related Internet use. This study provides important findings related to patterns of youth health-related Internet use. Although overall youth are frequent users of the Internet for their healthcare and are positive about their practice, there is still a great need for education for competent and appropriate use of the Internet for youth. Also, there is a need for developing more reliable Web-based sources for this population. The findings include the associated factors for health-related Internet use on adolescents’ general health behaviors. A major gap identified in the review was lack of a conceptual definition of “health-related Internet use.” Also, the majority of studies are not based on a theoretical framework. This review also identifies the limitation of the identified studies regarding methodological issues and provides suggestions for further rigorous research required to design efficient and effective interventions for this population. Healthcare providers and policy makers should integrate these needs into their current practices and policies.

Acknowledgements

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Conflicts of Interest
All authors do not have any personal or financial conflicts of interest for disclosure regarding this study.

**Abbreviations**

HRIU: health-related internet use

AA: African American

DM: diabetes mellitus

HS: high school

SNS: social networking sites

UG: undergraduate

UK: United Kingdom

USA: United States of America

yr: year

yrs: years

CINAHL: Cumulative Index of Nursing and Allied Health Literature

SNS: social networking sites

AIDS, acquired immunodeficiency syndrome

HIV: human immunodeficiency virus

d: day

hr: hour

hrs: hours

min: minutes

wk: week

mo: month

mos: months

r/t: related to
References


