Introduction

Health literacy (HL) is crucial to health as it is associated with a variety of health behaviours and a predictor of many health outcomes (Berkman et al, 2010; Paasche-Orlow and Wolf, 2010; Levin-Zamir et al, 2016). HL is not evenly distributed within the population or across the lifespan. Groups at risk for low HL include people with limited financial resources, members of minority ethnic groups – especially those with a mother tongue other than the local language – people with low educational attainment and older people (Nielsen-Bohlman et al, 2004; Vernon et al, 2007; ABS, 2008; Ng et al, 2014; Sørensen et al, 2015).

In a highly media-saturated and digitalised world, health information is increasingly available and accessed via diverse media. The skills to navigate this environment are strongly linked to HL, and as such are not equally distributed within the population. This chapter presents two constructs – media health literacy (MHL) and eHealth literacy (eHL) – and offers an overview of their associations with health behaviour both across different age groups and among special populations. Interventions to improve MHL and eHL are discussed, and conclusions for further research on health literacy and health behaviour in the digital era drawn.

Media health literacy and eHealth literacy

MHL (Levin-Zamir et al, 2011) is based on the foundations of health literacy and media literacy. The concept builds on the premise that unlike health content and information intentionally generated by the health system, mass media content is often implicit and can be either health promoting or health compromising. Based on the components of the Nutbeam model of HL (Nutbeam, 2000; see also Chapter 14, this volume), MHL is conceptualised as a continuum, ranging from the ability to identify health-related content (explicit and/or implicit) in the media; recognise its influence on health behaviour (comparable to functional HL); critically analyse the content (comparable to critical HL; see Chapter 11,
this volume); and express intention to respond through action (personal health
behaviour or advocacy) (comparable to interactive HL). Thus, the validated
measure of MHL is comprised of these four categories and was shown to be
highly correlated with health empowerment. As such, MHL can be considered
the precursor to eHL.

The rapidly growing number of digital health offers has led researchers to reflect
on the skills necessary for users to effectively navigate the services and health
information provided. Consequently, Norman and Skinner (2006b, p 1) coined
the term eHL, meaning ‘the ability to seek, find, understand, or appraise health
information from electronic sources and apply the knowledge gained to addressing
or solving a health problem.’ Tasks related to eHL are highly complex, and several
barriers to completion exist (Chan and Kaufman, 2011). To date, there is one
eHL measurement tool that has been used in different settings throughout the
globe: the eHealth Literacy Scale (eHEALS) by Norman and Skinner (2006a). It
consists of eight items for which respondents self-rate their ease and skills when
navigating the internet for valid health information. The original English scale
has been translated into many languages, including Japanese, Korean, German,
Italian, Spanish, Greek and Hebrew. Although widely used, its validity has been
questioned, mainly due to the lack of correlation between eHEALS scores and
actual task performance in online health information seeking (van der Vaart et
al, 2011; Quinn et al, 2017), and because it does not sufficiently address critical and
interactive health literacy skills (Norman, 2011; van der Vaart and Drossaert, 2017).

eHealth literacy, health information seeking and sociodemographics

The internet is an increasingly important source for health information. People
from different age groups, socioeconomic backgrounds and from diverse ethnic
groups refer to online sources when seeking information on health topics
(Borzekowski, 2009). As early as 2006, 80 per cent of adult American internet
users confirmed having browsed the web for health information (Fox, 2006). More
recently, similar numbers of online health information seeking have been shown
in Eurobarometer data from the 28 member states of the European Union (EU)
(European Commission, 2014). Among US college students, the internet even
appears to be the single most important source of health information (Rennis
et al, 2015). Still, socioeconomic differences in online health information seeking
have been reported. Studies showed low rates of online health information seeking
among older adults, among people with low educational attainment, in men
compared to women, and among adults belonging to minority ethnic groups

Frequent online health information seeking, the use of sophisticated search
strategies and thorough checking of identified health information sources
are indicators of high levels of eHL. According to Neter and Brainin (2012),
people with high eHL are younger and better educated than people with low
eHL scores. These associations are confirmed by data from various samples, for
example, financially disadvantaged US families (Knapp et al, 2011) and immigrant communities in Canada (Zibrik et al, 2015). High eHL levels were associated with the use of social media for seeking health information, and with frequent use of electronic devices in general (Tennant et al, 2015). Similarly, eHL scores were high for students actively involved in searching for health information online (Ghaddar et al, 2012). Data also suggest that parental online health information seeking was positively associated with adolescents’ eHL and engagement in online searches for health information (Chang et al, 2015).

eHL scores are positively associated with frequency of use of the internet (Choi and Dinitto, 2013; Richtering et al, 2017) or with the number of web searches for health information (Guendelman et al, 2017). This finding is consistent with theoretical considerations underpinning the development of the Integrative Model of eHealth Use (IMeHU). In the IMeHU, individuals with low eHL have lower self-efficacy regarding their Internet searches for health information. Similarly, low eHealth-literate individuals are theorised to have a low health information orientation, reducing their general motivation to seek health information. Both factors lead to reduced online health information-seeking efforts. This in turn means low engagement with online health information sources, and eHL levels remain low (Bodie and Dutta, 2008).

Digital health interventions and health behaviour

When examining the association between eHealth use, MHL and eHL and health behaviour, the importance of mobile apps should be considered. The global trend of mobile applications for promoting health behaviour in illness management, lifestyle modification and navigation of the healthcare system (Santo et al, 2016) deserves attention, as does the increase of health apps that focus on access to medical care and disease-specific apps (Hsu et al, 2016).

An increasing number of intervention studies suggest that digital tools are useful. A meta-analysis (Cushing and Steele, 2010) showed that eHealth interventions have promising results using a behavioural approach. The authors suggest that eHealth interventions make health-related goals more attainable by (1) breaking treatment goals into smaller, more manageable components, (2) automatically assessing success, and (3) modifying previously attained goals in response to programme success. A Cochrane review (Gurol-Urganci et al, 2013) showed moderate evidence regarding the benefits of mobile phone messaging interventions in increasing diabetic patients’ self-management capacity, in improving hypertensive patients’ rate of medication compliance and in affecting the peak expiratory flow variability for asthma patients. The review showed less evidence for the impact of eHealth on health service utilisation, and no evidence for long-term effects on health outcomes. Yet, a later review concluded that the mobile phone can be a tool to address gaps in access, coverage and equity in low-resource settings. Mobile health (mHealth) interventions showed a positive impact on chronic diseases in low- and middle-income countries (Beratarrechea et al, 2014).
Although digital tools for promoting health behaviour are highly accessible, their use is not consistent among all populations (Kontos et al, 2014). A systematic review of 74 studies suggests that most online health content is not adjusted to user readability levels and is therefore inaccessible (Kim and Xie, 2017). The authors added that even adults with high levels of health literacy sometimes evidenced low levels of self-efficacy, which deter finding reliable online information to inform health behaviours. However, an increasing body of knowledge suggests online sources of health information can be adapted to cultures, language and to groups with a particular status in society (Kreps and Neuhauser, 2010). For example, text-to-speech apps may help people with low health literacy to access important online health information (Kim and Xie, 2017).

The limited number of studies and participants support the need for continued research and a review of evidence on health outcomes and service utilisation. Most of the studies available have also tested technologies among populations with an illness or chronic condition. More studies are needed in order to draw more significant conclusions regarding populations at large.

**Media/eHealth literacy and health behaviour across the lifespan**

A large proportion of eHL research has focused on associations of eHL with individual variables and health information seeking. Recently, attention has shifted towards the relationship of eHL with health outcomes and health behaviours. The IMeHU (Bodie and Dutta, 2008) states that people with high eHL are inclined to seek health information online, have a good ability in understanding and evaluating the information they find, and use quality information retrieved from online sources to make informed health decisions. Applying IMeHU, studies have shown that the use of health information from the internet can affect dietary habits, physical activity levels and exercising (Dutta-Bergman, 2004; Lee et al, 2015). Although this branch of research is relatively recent, some of the few studies that have been published to date are presented in the following sections.

**Childhood**

The use of digital tools commences at an increasingly earlier age (Livingstone et al, 2017). Born into a media-rich environment, younger children are continually exposed to the media and digital world through mobile phones, tablets and other digital means, in addition to traditional media sources. Research on eHL in early childhood focuses mainly on young parents of babies and toddlers. Skranes et al (2015) found that Norwegian mothers’ self-efficacy could be improved and parental anxiety reduced using a specifically designed website. A meta-analysis of mHealth interventions for maternal, newborn and child health in low- and middle-income countries suggests simple interventions involving SMS messaging can improve rates of breastfeeding (Lee et al, 2016). More recently, eHealth
interventions have been applied to tackling the rising rates of obesity in early childhood, particularly as screen time is considered a risk factor for obesity. A meta-analysis (Hammersley et al, 2016) showed very few studies conducted between the ages of birth to five years, and as mentioned, those existing focused on the parents. As early childhood is important for establishing healthy lifestyles later in life, more research needs to be conducted on the association of digital media use and health outcomes. The evidence is even more scarce for associations between eHL/MHL and health behaviour in school-aged children. To our knowledge, no study explicitly investigating these relationships has been published to date, perhaps due to challenges in research implementation. Regarding eHL and MHL research, adolescence is the first developmental period where skill sets can be researched.

Adolescence

Early, middle and late adolescence are the first periods where the individual is considered independent, regarding his/her media use and health behaviour. A wealth of studies has proven the strong association between exposure to media and health behaviours in adolescence on into the transition into adulthood. Specifically, eating habits, substance use and abuse (cigarette smoking and alcohol use), sexual behaviour and violent behaviour have all been clearly correlated with exposure to related content in mass media, including the internet. The concept of MHL (Levin-Zamir et al, 2011) was developed and validated with respect to health behaviour among adolescents. Levels of MHL among 1,516 adolescents aged 13, 15 and 17 were predicted by socioeconomic determinants, including mother’s education and family income. MHL was also found to be significantly and positively associated with health behaviours among adolescents: nutrition, physical activity, sexual activity, safety behaviour and substance use. Also, competency in acquiring health information both online – that is, eHL – and offline are related to health behaviour: Chinese adolescents reported a higher intention to perform positive health behaviour when they felt more competent in obtaining health information (Lam and Lam, 2015).

Acknowledging that new channels of intervention need to be developed and applied for health promotion among adolescents, Wharf Higgins and Begoray (2012) developed the concept of critical media health literacy, whose attributes include skill sets, empowerment and competency of engaged citizenship. Regarding eHealth and eHL, Tercyak et al (2009) showed that eHealth interventions were acceptable to adolescents with multiple risk behaviours. Bitzer and colleagues (2016) reviewed tools for measuring eHL among children and adolescents, and are currently developing new measures as part of the Health Literacy in Childhood and Adolescence consortium (HLCA; see Chapter 15, this volume). Future studies that focus both on eHL and health behaviour among adolescents will contribute to the body of knowledge on the association between them.
Early adulthood

Two studies from Taiwan investigated the associations of eHL with health behaviours in nationally representative samples of college students. Hsu et al (2014) examined the interplay of individual factors, eHL and health behaviour. Their data showed that high eHL is associated with good self-reported health status and a high degree of health concern. Additionally, students with high eHL levels showed an increased likelihood of favourable dietary habits, physical activity levels and sleep patterns. Specifically, the domain of critical eHL, referring to skills needed to analyse and apply online health information, predicted positive health behaviour. The authors conclude that in order for online health information to influence one’s health behaviour, he/she not only needs to identify it, but also be able to critically appraise it. Yang et al (2017) investigated the association of eHL and positive health-promoting lifestyle behaviours, namely, the psychological health behaviours of self-actualisation, health responsibility, stress management and interpersonal support, as well as exercising and eating a healthy, balanced diet. They found that even when controlling for individual factors such as the degree of health concern, eHL levels remained positively associated with the six areas of positive health behaviour examined. However, the association was evidenced only for levels of critical eHL, stressing the importance of advanced skill sets to deal with online health information.

Adulthood

Data from South Korea suggest that eHL is the strongest predictor of health behaviour when controlling for general characteristics, such as gender, age, education and income. Participants generally agreed with statements indicating that online health information influenced health-related behaviours such as interacting with a healthcare professional or adopting a healthier lifestyle. The authors conclude that eHL can be an important factor in the promotion of individual positive health behaviour (Kim and Son, 2017). Mitsutake and colleagues (2016) examined eHL levels and their associations with health behaviour in a Japanese sample of adult internet users. eHL was significantly related to exercising and eating a healthy diet. However, the associations of eHL with the negative health behaviours of cigarette smoking, alcohol consumption and eating between meals were insignificant.

eHL is also linked to preventive health behaviours. An Israeli study on vaccination decisions of young children’s parents (Aharony and Goldman, 2017) analysed characteristics of subgroups of their sample: hesitant parents, especially vaccination refusers, reported a variety of search strategies and sources when looking for health information online. They also demonstrated abilities in evaluating the quality of the information retrieved. The authors conclude that parents who deliberately decided not to vaccinate their children had high levels of self-reported eHL. However, eHL of hesitant and non-hesitant parents did
not differ significantly. Thus, it remains to be further investigated how exactly online health information seeking, one’s perceived efficacy in evaluating and appraising said information (that is, eHL), attitudes and health behaviour are linked. Two additional studies on the association of eHL levels and preventive health behaviours produced contradictory evidence. While Mitsutake et al (2012) found a slight positive association of eHL levels with colorectal cancer screening practices, Park et al (2014) did not find a significant relationship between eHL and cancer screening tests.

**Older people**

eHealth, mHealth and other digital tools are often assumed to be relevant mainly for younger populations. However, older adults, especially those with chronic disease, report increasingly widespread use of these tools to positively influence health behaviour and self-management. A test for eHealth literacy has been validated for older adult populations (Chung and Nahm, 2015), although the population used for the validation was not completely representative (higher education and predominantly white, male). The use of the web by older adults for seeking information was studied by Leung et al (2007), noting that older adults who had high eHealth skills still preferred acquiring health information through face-to-face opportunities (Levin-Zamir et al, 2017).

**Special populations**

In a sample of 63 HIV-infected women from the Bronx, New York, researchers investigated the association of eHL and HIV transmission risk behaviours (Blackstock et al, 2016). In multivariate regression analysis, age and eHL were both positively associated with HIV transmission risk behaviours, even when adjusted for socioeconomic variables and health status. This finding is contrary to other findings reported above, where higher levels of eHL are associated with more positive health behaviours. The authors conclude that caution is warranted when drawing conclusions regarding the associations between eHL and health behaviour due to considerable variability based on the participants’ social status and the study design.

**eHL and MHL interventions throughout the lifespan**

A systematic review on eHL among college students concluded that even a young, well-educated population has major shortcomings in some areas of eHL, and that interventions to improve eHL would not only benefit traditional at-risk groups (Stellefson et al, 2011).

Several findings suggest that eHL levels can be improved through guidance in online health information-seeking activities as well as in structured learning environments. For example, Chang et al (2015) showed that active parental
mediation of their adolescent children’s internet use was related to adolescents’ eHL. Respondents in focus groups of Spanish primary school students reported use of the internet as a tool for learning about health topics and habits, but preferred their searches to be guided and supervised by their parents to promote their efficacy and confidence in dealing with online health content (Hernan-Garcia et al, 2015). Similarly, in a sample of elder Hispanics with type 2 diabetes, participants reported the internet as a useful information source about their condition, but often relied on the help of relatives and friends when assessing the information (Aponte and Nokes, 2017). Similar strategies have been observed for Mexican American breast cancer survivors in the US; managing online health information in their case was always a responsibility they shared with their offline social networks (Sørensen et al, 2009). Results from a nationally representative Israeli survey study indicate that participants with low eHL for whom finding someone (offline) to help them perform and analyse their online health information searches was easy, partly compensated for their lack of eHL through social support (Hayat et al, 2017). Caregivers or significant others’ guidance and support are thus vital in the development of abilities relevant to eHL. This is consistent with Nutbeam’s (2000) model of health literacy stating that the ability to extract and derive meaning from different forms of communication, referred to as communicative/interactive health literacy, is a key component of health literacy. Thus, not only is general health literacy critical for eHL (Norman and Skinner, 2006b), but also for interactive health literacy.

eHL can further be developed in structured learning environments. A systematic review on eHL intervention studies for older adults (Watkins and Xie, 2014) showed that eHL interventions were scarce, that only few of the available studies applied high-quality research design, and that many interventions were not theory-based. Still, some studies present promising results for eHL interventions. For example, Hernandez-Rabanal et al (2017) showed that even after a single training session on how to identify reliable health-related information and resources online, upper secondary school students showed a significant increase in self-reported eHL. An intervention to improve eHL of adolescents composed of three online training lessons administered during computer classes yielded significant, though marginal, improvements of eHL levels of the participating students. High involvement in intervention was one of the strongest predictors of changes in eHL, stressing the need to make eHL personally relevant to participants (Paek and Hove, 2012). A programme consisting of four two-hour sessions aimed at helping older adults perform online health information searches yielded significant improvements of eHL. Participants also reported changes in health-related attitudes and behaviours following participation (Xie, 2011a, b, c).

**Designing eHL/MHL interventions for different target groups**

Regarding eHL/MHL intervention, one size usually does not fit all. Expert consensus on methods to promote eHL in older adults emphasise the importance
of identifying the target population’s needs (Manafò and Wong, 2013). Focus groups with socioeconomically disadvantaged people from different ethnic groups living in the southwestern US showed that many participants avoided health information from ‘.edu’ or ‘.gov’ web pages due to perceived complexity and lack of trust in the government for health information (Mackert et al, 2009). Yet, an Australian sample with a high proportion of college graduates stressed their trust in government endorsement as a means to assess the quality of online health information (Kasparian et al, 2017). Trust in traditional authorities such as the government or academia should be taken into consideration when designing eHL interventions for specific populations.

Considering the target group is also highly critical when designing eHealth or mHealth tools intended to promote health-related behaviours. Coughlin et al (2016) emphasise the importance of the cultural tailoring of mHealth applications for weight control by considering the cultural dieting habits of the target population. Not only the content, but also presentation to the users matters greatly when designing eHealth tools (Meppelink et al, 2015). Finally, digital health interventions should be considered in context. In the case of diabetes literacy, a project that included eight European countries, Israel, Taiwan and the US, examined the effectiveness of a variety of self-management interventions for people with diabetes, the relative effectiveness of individual counselling, group intervention, self-help groups and eHealth tools. All interventions were proven effective in the countries’ contexts, including eHealth interventions, the main recommendation being that interventions must be accessible and available to all (Saha et al, 2017).

**Ethical challenges**

Ethical considerations must be exercised when researching and implementing interventions related to eHealth, MHL and eHL. Data safety and privacy issues are currently among the most important topics related to ethics. Consumers or patients need to be sure their data are safe and protected by the developers of the tools they engage with (Fernandez-Luque and Staccini, 2016). Kluge (2016) emphasised the need for a code of ethics, particularly for health information professionals.

As highlighted above, accessibility and comprehensibility of health information are major concerns. In the interests of equity, it is critical to ensure access to understandable and applicable health information to all populations, guaranteeing that no one is excluded and/or offering parallel and complementary avenues of access. Underserved populations, although they may have access to the internet, often show limited eHL (Connolly and Crosby, 2014). These groups may be under-represented in online eHealth and health behaviour research. For example, Cho et al (2014), authors of an important study examining the relationship between eHL, health app use efficacy, health consciousness and health information orientation, acknowledge that the sample included a high proportion of people
with college degrees, and a more representative sample would be needed to draw more generalised conclusions.

Frequent criticism directed at digital health offers is that the aim is to save manpower and to lower costs, and that they mainly benefit the healthcare industry but not the patients. Schneider et al (2013, p 1) assert that the purpose of internet-based health tools ‘is not to take over the roles of healthcare providers; on the contrary, [they] should reinforce the alliance between healthcare providers and patients’ as they allow patients and consumers to take on a more active role. Whether the tools in question will eventually succeed in empowering their users needs to be carefully assessed.

**Conclusion**

Evidence from theoretical and empirical work has highlighted the importance of traditional and digital media, especially internet-based tools, in relation to health literacy and health behaviour. The concepts of MHL and eHL as skill sets to obtain and apply health information from the media and online sources have been discussed in detail, and their associations with health behaviour across the lifespan presented. Electronic health offers have promising potential to support health information seeking and health behaviour change in many populations. Yet accessibility and comprehensibility might not be guaranteed for all social groups. Careful consideration of the inclusivity and target group specificity of such offers is therefore needed. In general, the field will benefit from further research as the evidence to date is limited.

**Future directions**

Due to rapid developments in the digital world, eHealth research is delicate and time-sensitive. For example, the above-mentioned and frequently cited conceptual model of eHL was questioned by its first author Cameron Norman (2011) five years after it was published. During this period, social media and Web 2.0 tools and environments were developed, making the original conceptualisation of eHL partly outdated. As is recognised in research on emerging technologies, it is highly probable that the technology or service in question becomes outdated by the time a theoretically and methodologically sound study to assess it is conceptualised, conducted and analysed, let alone its findings published (Baker et al, 2014). Research concerning MHL and eHL therefore needs to carefully consider whether the instruments and methodology used are able to reflect the current state of technology. Finally, future research is necessary regarding the extent to which digital and media tools can be considered a panacea for solving HL and health promotion challenges. The importance of continued research and reviews cannot be overstated due to the significant investment in innovative tools and their sweeping uptake by health systems globally.
References


