Digital Health: A Systematic Literature Review and Future Research Directions

Jens Grehling  
*University of Bamberg, jens@grehling-software.de*

Christian Maier  
*University of Bamberg, christian.maier@uni-bamberg.de*

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DIGITAL HEALTH: A SYSTEMATIC LITERATURE REVIEW AND FUTURE RESEARCH DIRECTIONS

Research Paper

Jens Grehling, University of Bamberg, Germany, jens@grehling-software.de
Christian Maier, University of Bamberg, Germany, christian.maier@uni-bamberg.de

Abstract

With the widespread diffusion of using Information Systems (IS), we see ambivalent effects on individual’s health. On the one hand, IS use has favourable effects on an individual’s health, such as reducing mortality. On the other hand, we see unfavourable effects of IS use, including technostress-induced job burnout and sleep problems. To provide an overview of research in that stream, we review literature anchored around the topic of digital health. Following the grounded-theory method, we identify 41 articles in the major IS journals and classify them by providing a) three forms of digital health (mental, physical, and social), b) three causes of digital health (individual, environmental, and technological), and c) the relationships between causes and forms. With that, we contribute to digital health research with a more nuanced understanding of causes, forms, and their relationships. We come up with fruitful avenues for future research.

Keywords: Digital health, Dark side of IT, Well-being, IS usage, Technostress, Literature review.

1 Introduction

The usage of Information Systems (IS) has several favourable as well as unfavourable effects on individuals’ health (Maier et al., 2021; Califf et al., 2020). Focusing on favourable effects, the use of eHealth kiosks, providing authenticated medical information in rural India, is shown to reduce infant mortality, e.g. by helping to overcome dangerous traditional health literacy (Venkatesh et al., 2016). Similar to that, every fifth adult in the U.S. uses fitness trackers (Mccarthy, 2019), e.g. for strength and conditioning training (Wu et al., 2016). Focusing on unfavourable effects, among other things, the use of IS causes technostress which fosters perceptions of exhaustion (Ayyagari et al., 2011), and increases the number of individuals that suffer job burnout (Maier et al., 2019), depression (Wright, 2018), and sleep problems (Salo et al., 2019). Irrespective if the health effects are favourable or unfavourable, individuals use the IS, which then has the mentioned effects on an individual’s health, due to a wide range of different causes. In the example of eHealth kiosks, individuals use the kiosks as their social network recommends this way to improve health literacy, and thereby make sick children healthy again (Venkatesh et al., 2016). In the unfavourable example of technostress, individuals use IS to increase, among others, their availability (Ayyagari et al., 2011) or distract from real-world problems (Tarafdar et al., 2020).

Research that tackles these examples is anchored around the topic of digital health. Generally spoken, digital health refers to the individual health consequences of IS usage (Kostkova, 2015; Montagni et al., 2018) that are either favourable or unfavourable (see box in Figure 1). With that definition, digital health does not focus on specific technologies (Laumer et al., 2019), but centres the individual, who improves (e.g., increased fitness) or worsens (e.g., technostress-induced job burnout) her health due to using IS. Aligning with the examples above, we see two issues. First, there is a wide range of different forms of digital health, including the reduction of infant mortality in rural India as a physical form of digital health or exhaustion and job burnout in the technostress example as a mental form of digital health.

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Digital health

Second, we also see different causes of digital health that influence the IS usage. These are, among others, grounded in technological characteristics, as we see in the technostress example, where the increase of individual’s availability is only made possible through respective technology features. In the eHealth kiosk example, recommendations of the user’s social network are considered as the cause for why the IS is used.

![Digital health diagram](image)

**Figure 1.** Overview of different concepts used in that paper to study digital health (this review focuses the parts highlighted in grey).

Previous research has tackled the topic of digital health and thereby has offered valuable insights into different forms of digital health as well as their causes. Despite these initial investigations in the stream of IS research, we see three shortcomings. First, there is no given overview of different forms of digital health and their favourability. We need this overview, to synthesize previous empirical findings into a better comprehensible form. Thereby, we gain a better understanding of digital health itself, and carve out avenues for future research. Second, an overview of possible causes of digital health is missing. This understanding allows us to recognize the aspects that have an influence on digital health. Thereby, these causes can be investigated regarding their effects on an individual’s health and IS users can be properly informed about possible health consequences. Third, there is no previous research uncovering which causes of digital health influence which forms of digital health. Knowledge about these relationships allows to focus on the relevant causes for certain health consequences an individual is experiencing. Thereby, unfavourable digital health can be weakened by hindering the causes, or favourable digital health can be strengthened by reinforcing the causes. In sum, an overview of digital health helps us to find ways to use IS in the healthiest possible manner. We provide this overview of present knowledge about digital health by examining the following research question:

**What is the current state of research about forms of digital health and its causes in the field of IS?**

To respond to the research question, we review the top eight journals from IS research (AIS Senior Scholars’ Basket). To analyse the search results we use the grounded-theory-based review method (Wolfsink et al., 2013). Our results show that there are three different forms of digital health, namely physical, mental, and social digital health. We show that literature mostly investigates favourable physical digital health and unfavourable mental and social digital health. This is complemented by three causes of digital health that are individual, environmental, and technological causes. We investigate relationships between causes and forms of digital health. Thereby, we uncover that technological causes do not influence physical digital health and environmental causes do not influence social digital health. Based on these insights, we develop avenues for future research. For example, future research might study favourable mental and social digital health, and unfavourable physical digital health.

The following of this review is organized as follows: Section 2 explains the methodology for the literature review. Section 3 presents the results of the analysis of the literature. Section 4 explains our
contributions to research and practical implications. Afterwards, we show avenues for future research and draw limitations. Section 5 concludes with a call for further research on digital health.

## 2 Research Methodology

We follow the methodology for a grounded-theory based literature review to develop an understanding of the digital health construct from previously published literature (Wolfswinkel et al., 2013). We choose this methodology because it allows for a more integrated and fruitful theory emergence (Wolfswinkel et al., 2013), which helps us to understand the new themes and relationships in the area of digital health. This method has widely been used by other recent reviews targeting to create an overview of a certain field (Senyo et al., 2019; Vial, 2019). Therefore, we select and analyse studies about digital health, to uncover different forms of digital health, its causes, and the relationships between these concepts. This review methodology consists of five steps, namely define, search, select, analyse, and present. The first four steps are explained in the following. The last step, present, is included in section 3. An overview about our search strategy is given in Table 1.

<table>
<thead>
<tr>
<th>Step</th>
<th>Explanation of each step</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Define</td>
<td>We define all available volumes of AIS Senior Scholars’ Basket journals as our literature source.</td>
</tr>
<tr>
<td>2. Search</td>
<td>We search on each of the journal websites with the keyword “health” in all fields.</td>
</tr>
<tr>
<td>3. Select</td>
<td>We select articles that are published before October 2020, provide empirical results and investigate forms of digital health or their causes.</td>
</tr>
<tr>
<td>4. Analyse</td>
<td>We analyse and code the selected articles for forms of digital health, their causes and relationships between these constructs.</td>
</tr>
<tr>
<td>5. Present</td>
<td>We present our findings in section 3.</td>
</tr>
</tbody>
</table>

Table 1. Steps of our grounded-theory-based literature review (Wolfswinkel et al., 2013).

In the define step, appropriate sources are determined, specific search terms selected, and the inclusion criteria for the literature defined (Wolfswinkel et al., 2013). To synthesize existent literature, we choose the AIS Senior Scholars’ Basket journals as literature sources, as they represent the top journals in the field of IS. We consider the literature of these major journals to be representative for our subject. All available volumes of the journals are considered in the search. We include only literature that meets the following criteria. First, it is published in one of the selected journals until October 2020. Second, it provides empirical results (qualitative or quantitative), as our review focuses on research outcomes, namely forms of digital health, their causes, and the relationships between the causes and the different forms. Third, it investigates forms of digital health, meaning the health consequences of IS usage or their causes. With our broad understanding of digital health as presented in the introduction, we search for “health” as keyword to cover all studies investigating health-related topics.

<table>
<thead>
<tr>
<th>Journal</th>
<th>Hits</th>
<th>Selected</th>
</tr>
</thead>
<tbody>
<tr>
<td>European Journal of Information Systems</td>
<td>337</td>
<td>4</td>
</tr>
<tr>
<td>Information Systems Journal</td>
<td>257</td>
<td>6</td>
</tr>
<tr>
<td>Information Systems Research</td>
<td>300</td>
<td>9</td>
</tr>
<tr>
<td>Journal of AIS</td>
<td>190</td>
<td>0</td>
</tr>
<tr>
<td>Journal of Information Technology</td>
<td>334</td>
<td>1</td>
</tr>
<tr>
<td>Journal of MIS</td>
<td>406</td>
<td>9</td>
</tr>
<tr>
<td>Journal of Strategic Information Systems</td>
<td>179</td>
<td>3</td>
</tr>
<tr>
<td>MIS Quarterly</td>
<td>54</td>
<td>9</td>
</tr>
</tbody>
</table>

Table 2. Selected 41 articles by journals.
In the search step, we search in each of the eight journals for the keyword “health” in title, abstract, keywords or the full text. We search directly on the website of each journal separately. We do not apply further filter criteria. Our search results in 2,057 articles.

In the select step, we start the selection by screening the titles and abstracts and finally full texts of the studies for forms of digital health and its causes. We only include results if they match the defined inclusion criteria from the define-step (Wolfswinkel et al., 2013). This implies that we remove results for such reasons as the following three. First, we remove results about digitalisation in the healthcare industry, that do not use a form of digital health as a dependent variable because they do not advance our understanding of digital health (Sun et al., 2020; Wang et al., 2020; Osatuyi and Turel, 2020). This applies to many articles and explains most of the difference between the search result count, and the amount of finally selected articles. Second, we remove studies with intentions to decrease or stop the usage of an IS as a dependent variable, even if the previous behaviour was classified as unhealthy (Chen et al., 2020; Maier et al., 2015) because these studies do not intend to investigate health consequences and thereby are not related to digital health. Third, we exclude studies that are not related to IS usage, such as work-specific causes of burnout for IS professionals (Pawlowski et al., 2007), which is only related to the IS profession and not to IS usage and, therefore, does not match our definition of digital health. This leads to a total of 41 included articles. Table 2 shows the count of hits in each journal and the corresponding count of selected publications.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Health consequence (open coding)</th>
<th>Form of digital health (axial coding)</th>
<th>Favourability of health consequence</th>
<th>Causes of digital health (open coding)</th>
<th>Cause category (axial coding)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ayyagari et al., 2011</td>
<td>Exhaustion</td>
<td>Mental health</td>
<td>unfavourable</td>
<td>Usability features</td>
<td>Technological cause</td>
</tr>
<tr>
<td>James et al., 2017</td>
<td>Online social network obsession-compulsive-disorder</td>
<td>Mental health</td>
<td>unfavourable</td>
<td>Online social network belongingness</td>
<td>Individual cause</td>
</tr>
<tr>
<td>Lin et al., 2017</td>
<td>Prediction of health events</td>
<td>Physical health</td>
<td>favourable</td>
<td>Patient information</td>
<td>Individual cause</td>
</tr>
<tr>
<td>Devaraj and Kohli, 2000</td>
<td>Reduction of mortality rate</td>
<td>Physical health</td>
<td>favourable</td>
<td>Technology investment</td>
<td>Environmental cause</td>
</tr>
<tr>
<td>Salo et al., 2019</td>
<td>Identity problems Social relation problems</td>
<td>Social health</td>
<td>unfavourable</td>
<td>Self-disclosure features</td>
<td>Technological cause</td>
</tr>
<tr>
<td>Kuem et al., 2020</td>
<td>Conflict (damaged relationships)</td>
<td>Social health</td>
<td>unfavourable</td>
<td>Personal innovativeness in IT</td>
<td>Individual cause</td>
</tr>
</tbody>
</table>

*Table 3. Examples for coding in reviewed articles.*

In the analyse step, we investigate the selected literature following the three sequential steps open coding, axial coding, and selective coding (Wolfswinkel et al., 2013). Open coding is the excerpting of passages about digital health and its causes in the selected studies, resulting in codes. Through axial coding, these codes are condensed into categories for forms of digital health and its causes. Selective coding is then used to integrate the identified categories and thereby uncover relationships between them. In the following, we will demonstrate how we apply the three steps in this review.
First, we use open coding to excerpt the relevant forms of digital health and its causes in the analysed literature. For many studies, forms of digital health and its causes are directly included in the research model. For example, we openly-code, “exhaustion” (Ayyagari et al., 2011) as one specific form of digital health and “usability features”, “intrusive features” and “dynamic feature” (Ayyagari et al., 2011) as causes of digital health. If the cause cannot be seen in the research model, we extract it from the discussed results in the publication. This results in a list of codes for forms of digital health and its causes.

Second, we use axial coding to develop different categories for the forms of digital health and its causes based on these codes. For example, we find the specific form of digital health “exhaustion” (Ayyagari et al., 2011), as well as “online social network obsessive-compulsive-disorder” (James et al., 2017) to be part of mental health and therefore we create mental digital health as a form of digital health. Likewise, the mentioned causes of digital health “usability features”, “intrusive features” and “dynamic feature” (Ayyagari et al., 2011) as well as “self-disclosure features” and “information cue paucity“ (Salo et al., 2019) are technological causes of digital health, which is why we create the corresponding category. In each form of digital health, we differentiate between favourable and unfavourable digital health, regarding their favourability for the individual. The mentioned forms of digital health “exhaustion” and “online social network obsessive-compulsive-disorder” are unfavourable. Other forms of digital health such as the “reduction of infant mortality” (Venkatesh et al., 2016) are favourable. This results in a categorisation of each code of digital health into a form of digital health, as well as a differentiation between favourable and unfavourable. Each of the coded causes is categorized into a category of digital health causes. Further examples of axial coding are shown in Table 3.

Third, we use selective coding to relate the categories to each other. It shows that certain categories of causes, such as technological causes, influence certain forms of digital health such as mental digital health. We use the developed forms of digital health and the causes of digital health to create a comparison of investigated relationships. We differentiate between investigated favourable and unfavourable digital health for each relationship and thereby allow for a comparison by favourability based on the investigated literature (see Table 6).

3 Results

In this section we explain the analysis from section 2 and conduct the present step from the grounded-theory-based methodology (Wolfswinkel et al., 2013).

We provide an overview of forms of digital health and its causes by reviewing 41 articles. Results show an increasing amount of publications in the field of digital health over the last years (see Figure 2). This increase of publications per year underpins the interest of the IS research community in this topic.
Our review reveals three forms of digital health as well as three causes (see Figure 3). The forms of digital health are **mental digital health**, **physical digital health**, and **social digital health**. Results also show that there can be favourable and unfavourable digital health for each form, with the one exception of favourable social digital health, which is not seen in the reviewed literature. The causes of digital health are summarised into **individual causes**, **environmental causes**, and **technological causes**. We start by explaining the forms of digital health, followed by their causes (section 3.1). After that, we describe which relationships between causes and forms of digital health exist in the reviewed literature and come up with some examples (section 3.2). While doing this, we differentiate between investigated favourable and unfavourable digital health.

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**Figure 2. Evolution of 41 articles about digital health.**

**Figure 3. Resulting structure of digital health.**
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3.1 Forms of digital health and its causes

Starting with forms of digital health, we see the three forms: mental, physical, and social (see Table 4). **Mental digital health** reflects a state of an individual’s psychological and emotional well-being. This encompasses on the one hand favourable mental digital health such as positive emotions (Wenninger et al., 2019) or subjective vitality (James et al., 2019). On the other hand, we see unfavourable mental digital health, including burnout (Srivastava et al., 2015), technostress (Tarafdar et al., 2007), exhaustion (Ayyagari et al., 2011), anxiety (Wright, 2018), depression (Wright, 2018), sleep problems (Salo et al., 2019) and addiction (Kuem et al., 2020). **Physical digital health** reflects an individual’s state of being able to perform physical activities without being hindered by physical limitations and experiences of bodily pain. For favourable physical digital health, we see e.g. improved diabetes management (Kelley et al., 2011), reduced mortality (Venkatesh et al., 2016), and early detection or prediction of illnesses such as breast cancer (Ahsen et al., 2019). For unfavourable physical digital health, we see a higher prevalence of HIV by using advertisement websites for matchmaking (Chan and Ghose, 2012). **Social digital health** emerges from the literature as an individual’s social relationships and networks, social support, social participation, and social inclusion. We only see unfavourable social digital health in that direction, e.g. social relation problems (Salo et al., 2019) and damaged relationships (Kuem et al., 2020).

<table>
<thead>
<tr>
<th>Form of digital health</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mental digital health (adjusted from Herman et al., 2005)</td>
<td>Mental digital health reflects a state of individual’s psychological and emotional well-being, in which it realizes his or her own abilities.</td>
</tr>
<tr>
<td>Physical digital health (adjusted from Capio et al., 2014)</td>
<td>Physical digital health reflects an individual’s state of being able to perform physical activities without being hindered by physical limitations and carry out social roles that are not hindered by physical limitations, experiences of bodily pain, and biological health indicators.</td>
</tr>
<tr>
<td>Social digital health (adjusted from Waite, 2018)</td>
<td>Social digital health reflects an individual’s state of well-being in which it has social relationships and networks, social support, social participation, and social inclusion.</td>
</tr>
</tbody>
</table>

Table 4. Explanation of forms of digital health.

Second, we develop three categories of causes of digital health (see Table 5). **Individual causes** of digital health are rooted in the user of the IS. This encompasses her characteristics, behaviours, and attitudes. These are, for example, user characteristics such as the user’s centrality in her social network (Venkatesh et al., 2020), and age (Saunders et al., 2017). Attitudes include the user’s disposition to her job (Bala and Bhagwatwar, 2018), her positive or negative affect (Wang and Lee, 2020), and her exercise goals (James et al., 2019). Finally, the previous usage of IS also causes future IS use and thereby digital health. For example the intensity of usage (Bala and Bhagwatwar, 2018) or positive reinforcement through usage (Kwon et al., 2016) are shown to influence digital health. **Environmental causes** are rooted outside of the user. This encompasses the allocation of IS infrastructure, the characteristics and behaviours of the user’s social network, and network effects. For example, online reviews about the hygiene in restaurants (Mejia et al., 2019), or entries on Craigslist, which is a website featuring free online classified ads (Chan and Ghose, 2012), facilitate the IS use of other individuals by adding value to the IS. Furthermore, financial investments in IT, for example in healthcare IT (Devaraj and Kohli, 2000), or IT infrastructure (Ganju et al., 2015) influence digital health. Finally, the social network of a user influences digital health, for example by receiving advice regarding her use from acquaintances (Venkatesh et al., 2016). **Technological causes** of digital health are rooted in the used IS. This encompasses the characteristics of the IS, such as its usability, or its overall functionality. This includes for example self-disclosure features (Salo et al., 2019), interactivity (Wang and Lee, 2020), and fitness technology feature sets (James et al., 2019).
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<table>
<thead>
<tr>
<th>Cause of digital health</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual causes</td>
<td>Individual causes of digital health are rooted in the user of the IS. They encompass her characteristics, behaviours, attitudes, and impacts of previous IS use.</td>
</tr>
<tr>
<td>Environmental causes</td>
<td>Environmental causes of digital health are rooted outside of the user. This encompasses the allocation of IS infrastructure, the characteristics and behaviours of the user’s social network, and network effects.</td>
</tr>
<tr>
<td>Technological causes</td>
<td>Technological causes of digital health are rooted in the used IS. This encompasses the characteristics of the IS, such as its usability, or its overall functionality.</td>
</tr>
</tbody>
</table>

Table 5. Explanation of causes of digital health.

3.2 Relationships between causes and forms of digital health

Previous research has not only studied the causes and forms of digital health separately. All reviewed articles analyse which of the causes influence which forms of digital health. Therefore, we focus on the three causes of digital health and present how these influence the single forms of digital health. We differentiate between favourable and unfavourable digital health for each of the forms and provide specific examples. An overview of all previously studied relationships is provided in Table 6.

We identify that individual causes influence mental, physical, and social digital health. In the reviewed literature individual causes influence favourable and unfavourable mental digital health. Individual causes of favourable mental digital health include giving feedback to other social network services (SNS) users, which creates positive emotions (Wenniger et al., 2019). Another example is the user’s exercise goal leading to increased subjective vitality through fitness tracker usage (James et al., 2019). Unfavourable mental digital health includes, among others, the users’ disposition towards her job influencing emotional exhaustion (Bala and Bhagwatwar, 2018). Furthermore, the user’s polychronicity is shown to influence overload (Saunders et al., 2017). For physical digital health, literature only focuses on how individual causes influence favourable physical digital health. For example, patient and diagnosis information of the user (Lin et al., 2017) allows the prediction of health events such as stroke. IS knowledge and self-efficacy influence eHealth management systems usage and thereby improve the handling of chronic diseases, such as diabetes (Kelley et al., 2011) or congestive heart failure (Bao et al., 2020). Individual causes influence only unfavourable social digital health. This includes the individual perception of loneliness and innovativeness in IT leading to conflict and damaged relationships through the addictive use of smartphones (Kuem et al., 2020). Furthermore, SNS overdependence and overload lead to social relation problems (Salo et al., 2019).

Environmental causes influence mental and physical digital health. For mental digital health, environmental causes influence only favourable mental digital health, such as the availability of internet and mobile phones leading to an increased well-being (Ganju et al., 2015). For physical digital health, environmental causes influence favourable and unfavourable digital health. Favourable physical digital health includes the integration of health IT (Pinsonneault et al., 2017), the availability of electronic health records (Lin et al., 2019), and automation of health processes (Aron et al., 2011) influencing the quality of care in hospitals. Furthermore, the advice of an individual’s social network increases the usage of eHealth kiosks in rural India and thereby facilitates infant mortality reduction (Venkatesh et al., 2016). Another example is the availability of predictive analytics whose usage enables the user to predict breast cancer (Ahsen et al., 2019) and patient readmission to hospitals (Ben-Assuli and Padman, 2020). Regarding unfavourable physical digital health, the count of entries on Craigslist, a website featuring free online classified ads, leads to an increase in the prevalence of HIV cases (Chan and Ghose, 2012).

Technological causes influence mental and social digital health. For mental digital health, technological causes influence favourable and unfavourable mental digital health. Regarding favourable mental digital health, the reviewed literature shows that applying information scent to websites leads to stress reduction (James et al., 2019). Furthermore, the affordances of online games lead to mood improvements (Lee et al., 2020). For unfavourable mental health, we see that being always available creates exhaustion...
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(Ayyagari et al., 2011). Additionally, push notification features are shown to increase concentration problems (Salo et al., 2019). Technological causes influence only unfavourable social digital health. For example, self-disclosure features and multipurpose functionalities increase social relation problems (Salo et al., 2019).

<table>
<thead>
<tr>
<th>Cause of digital health</th>
<th>Form of digital health</th>
<th>Favourability of digital health</th>
<th>Article count</th>
<th>References</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual cause</td>
<td>Mental digital health</td>
<td>Favourable</td>
<td>3</td>
<td>Yan and Tan, 2014; James et al., 2019; Wenninger et al., 2019</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unfavourable</td>
<td>12</td>
<td>Tarafdar et al., 2007; Turel and Serenko, 2012; Xu et al., 2012; Kwon et al., 2016; Turel and Qahri-Saremi, 2016; James et al., 2017; Saunders et al., 2017; Vaghefi et al., 2017; Bala and Bhagwatwar, 2018; Wright, 2018; Salo et al., 2019; Wang and Lee, 2020</td>
</tr>
<tr>
<td></td>
<td>Physical digital health</td>
<td>Favourable</td>
<td>6</td>
<td>Kelley et al., 2011; Yan and Tan, 2014; Lin et al., 2017; Chen et al., 2019; Bao et al., 2020; Venkatesh et al., 2020</td>
</tr>
<tr>
<td></td>
<td>Social digital health</td>
<td>Unfavourable</td>
<td>2</td>
<td>Salo et al., 2019; Kuem et al., 2020</td>
</tr>
<tr>
<td></td>
<td>Mental digital health</td>
<td>Favourable</td>
<td>2</td>
<td>Ganju et al., 2015; Liu et al., 2020</td>
</tr>
<tr>
<td>Environmental cause</td>
<td>Physical digital health</td>
<td>Favourable</td>
<td>15</td>
<td>Devaraj and Kohli, 2000; Kane and Alavi, 2008; Urquhart et al., 2008; Aron et al., 2011; Angst et al., 2012; Menon and Kohli, 2013; Bardhan et al., 2015; Venkatesh et al., 2016; Pinsonneault et al., 2017; Ahsen et al., 2019; Lin et al., 2019; Mejia et al., 2019; Ben-Assuli and Padman, 2020; Liu et al., 2020; Venkatesh et al., 2020</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Unfavourable</td>
<td>1</td>
<td>Chan and Ghose, 2012</td>
</tr>
<tr>
<td></td>
<td>Mental digital health</td>
<td>Favourable</td>
<td>3</td>
<td>Moody and Galletta, 2015; James et al., 2019; Lee et al., 2020</td>
</tr>
<tr>
<td></td>
<td>Unfavourable</td>
<td>6</td>
<td>Ayyagari et al., 2011; Turel and Serenko, 2012; Srivastava et al., 2015; Salo et al., 2019; Lee et al., 2020; Wang and Lee, 2020</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Social digital health</td>
<td>Unfavourable</td>
<td>1</td>
<td>Salo et al., 2019</td>
</tr>
</tbody>
</table>

Table 6. Classification of the reviewed literature.

Overall, the analysed literature includes 25 favourable and 17 unfavourable specific forms of digital health. Our study shows that the reviewed literature focuses on unfavourable mental and social digital health as well as favourable physical digital health.

4 Discussion

Digital health, possibly being favourable or unfavourable for an individual, has due to the increasing use of IS a high significance for our society. This study provides an overview of research in the stream of digital health. With that, we identify different forms and causes of digital health. In the following, we
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explain our contributions to research in digital health and practical implications. Afterwards, we show avenues for future research and draw limitations.

4.1 Contributions to Research

In our literature review, we identify 41 articles and, thereby, see an increase of articles published over the years with the topmost value in that year (see Figure 2). With that indication, we contribute that IS research considers digital health as an increasingly important field of research. We structure this section, deriving general contributions, into three parts, which will follow the three concepts from our review: forms of digital health, causes of digital health, and relationships between causes and forms of digital health (see Figure 3).

We contribute three forms of digital health. Previous research in the field of digital health has tackled many different concepts of digital health. This includes, among other things, mortality reduction (Venkatesh et al., 2016), subjective vitality (James et al., 2019), exhaustion (Ayyagari et al., 2011), job burnout (Maier et al., 2019), depression (Wright, 2018), and sleep problems (Salo et al., 2019). We classify all these separate concepts into three forms of digital health: First, mental digital health, which we consider as the consequences of IS use on an individual’s psychological and emotional well-being. Second, physical digital health, which emerges from the review as consequences of IS use on an individual’s state of being able to perform physical activities without being hindered by physical limitations and experiences of bodily pain. Third, social digital health, which are consequences of IS use that influence an individual’s social relationships and networks, social support, social participation, and social inclusion. Throughout all, on the one hand, we see favourable digital health, such as an increase in an individual’s overall well-being (Ganju et al., 2015) and improved chronic disease management (Kelley et al., 2011). On the other hand, we also see unfavourable digital health such as burnout (Srivastava et al., 2015) and exhaustion (Ayyagari et al., 2011). Nevertheless, the prevalence of favourable and unfavourable digital health varies between the forms of digital health. For mental digital health, the reviewed literature mostly focuses on unfavourable digital health, while the investigated physical digital health is mostly favourable. For social digital health, there is only unfavourable digital health. Thereby, we make four contributions to digital health research from an overall perspective. First, we confirm that digital health can be favourable and unfavourable, depending on the respective effects on an individual’s health. Second, we show that previous research has focused on favourable physical digital health on the one hand and unfavourable mental and social digital health on the other hand. Third, we uncover that favourable social digital health is not investigated in the reviewed literature. Fourth, we structure previous findings in three forms of digital health. This allows the classification of previous and future research in the field of digital health.

We contribute three causes of digital health. Similar to the forms, we see a big variety of causes of digital health in previous research. These include intrusive, dynamic, and usability features of the IS (Ayyagari et al., 2011), advice of an individual’s social network (Venkatesh et al., 2016), and the individual’s disposition towards her job (Bala and Bhagwatwar, 2018). We classify them into three categories, namely individual causes, environmental causes, and technological causes of digital health. First, we classify individual causes that are rooted in the user of the IS. They encompass the user’s characteristics, behaviours, and attitudes. Furthermore, the previous usage of IS influences the user’s future use, which we also consider as an individual cause of digital health. Second, we classify environmental causes that are rooted outside of the user. This encompasses the allocation of IS infrastructure, the characteristics and behaviours of the user’s social network, and network effects. Third, we classify technological causes that are rooted in the used IS. This are the characteristics of the IS, such as its usability, or its overall functionality. Summing up, we contribute to digital health research by structuring previous findings and thereby showing that research has tackled three causes of digital health. That knowledge can be used by future research to understand how these causes influence the user and their behaviour over time (Maier, 2020). Among others, it offers a valuable lens to explain that, for example, the usability is one important technological cause for why individuals use the post-cancer stress management app “StressProffen” (Børøsund et al., 2018).
We contribute relationships between forms and causes of digital health. After classifying forms and causes of digital health, we can identify relationships between them. For mental digital health, there are environmental, individual, and technological causes. This contributes, that whenever mental digital health should be influenced, all the causes of digital health need to be considered as influential. For physical digital health, we see environmental and individual causes. This contributes in two ways. First, technological causes are not shown to influence physical digital health. Second, when environmental and individual causes are investigated, their influence on physical digital health needs to be considered. For social digital health, there are individual and technological causes. This also contributes in two ways. First, environmental causes are not shown to influence social digital health. Second, social digital health can be influenced by environmental and individual causes.

4.2 Practical Implications

In practice, unfavourable mental digital health should provoke attention, similarly to private IS users and managers. Every private user should have in mind that using IS has the power to lead to unfavourable mental digital health. Thereby, users should limit their usage of the IS or at least be aware of possible unfavourable effects. When thinking about IS usage in organisations, managers are responsible to what IS is used by their employees. Due to that, managers should establish and create an environment which reduces unfavourable mental digital health for their employees, e.g., by providing the conditions for physical activity. One recent trend that can be seen in practice and research is providing yoga classes or training mindfulness. If this does not help to reduce the unfavourable effects on employees’ health, managers should at least start health interventions at an early stage, such as creating a recreational room, or encourage physical activity. Another possibility is, for example, to integrate features in products that decrease adverse outcomes, such as a possibility to disable notification features. With all these approaches, managers might minimize the costs of illness-related absence and take care of the health of their employees.

4.3 Future Research and Limitations

Based on our contributions we uncover the need for future research and identify potential directions. In this section, we derive implications for future research and draw limitations.

We derive three implications for future research, tackling the forms of digital health. First, research has mostly focused on favourable and only once on unfavourable physical digital health. That is, it is studied that the regional amount of Craigslist users increases HIV cases is that region (Chan and Ghose, 2012). However, we know from ergonomics research that office work is connected with musculoskeletal disorders (Piranveys et al., 2016). It is assumable that using IS on a personal computer or frequent usage of a mobile phone could lead to the same health consequences, which would be unfavourable physical digital health. To prevent IS users from suffering from unfavourable consequences of IS use, we need to understand which exist. Therefore, we suggest that further research should investigate unfavourable physical digital health. Second, while research has focused on unfavourable mental effects, such as job burnout (Srivastava et al., 2015) and exhaustion (Ayyagari et al., 2011) there is room for complementing research on favourable mental digital health. This is grounded in the fact that technostress research has found technostress leading to favourable effects (Maier et al., 2021; Califf et al., 2020). If technostress can cause positive outcomes, such as an increased motivation of the user (Califf et al., 2020) it can be assumed that IS use can also lead to favourable health consequences. Therefore, we suggest that further research focuses on favourable mental digital health. Third, research has focused on unfavourable social digital health outcomes, such as social relation problems (Salo et al., 2019) and damaged relationships (Kuem et al., 2020). IS research has already shown, that SNS are used to maintain contact with friends and make new friends (McCann, 2011). Therefore, it is plausible, that SNS use can improve social capital and thereby social health. It is important to understand, when and how IS can influence favourable social digital health to optimise health consequences. Therefore, we suggest that future research focuses on favourable social digital health.
We also derive an implication for future research, tackling the relationships between causes and forms of digital health. In previous digital health research, only two articles have included personality traits as influencing factors for digital health (Maier et al., 2019). Personality traits, often reflected by the big five (Gosling et al., 2003), are a valuable influencing factor for users’ adoption, e.g. of the internet in general (Landers and Lounsbury, 2006) and SNS specifically (Liu and Campbell, 2017). Furthermore, they are shown to influence the ability of an individual to cope with stress (Penley and Tomaka, 2002). Based on that, we assume that digital health is influenced in diverse settings by personality traits of the user. Knowledge about influences of the big five on digital health allows to differentiate between persons that are highly susceptible to influences on digital health and others that are not. Thereby, the effort for interventions against unfavourable digital health can be focused on these susceptible persons. Therefore, we recommend future research to investigate the influence of personality traits on digital health.

This study is limited in some ways. First, although we conduct our literature search in all major IS journals without any limitation for the publication date, there might be articles relevant to our topic that were not included in our review. This might be because they are not published in the journals we searched through or do not contain our superordinate search term “health” but only name specific illnesses. These articles might bring up different causes and forms of digital health, and thereby lead to a different categorisation. Second, we do not differentiate between the contexts, in which the IS is used. It might be, that the forms and causes of digital health depend on the context of IS usage, and therefore, other results would emerge. We call for future research, to complement our findings on digital health and overcome the limitations of this work.

5 Conclusion

In times of increasing IS usage, it is important to understand which health consequences arise. So, we analyse previous IS studies with the grounded theory-based method and develop a taxonomy for causes and forms of digital health. It appears that unfavourable, as well as favourable forms of digital health exist, which are influenced by different causes. Thereby, we create an overview of the current state of research. With that, we contribute with a detailed understanding of forms, causes and their relationships and develop specific future research directions on these. This helps to design, and use IS in the healthiest possible manner.

References


