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ORIGINAL PAPER

Health Anxiety in Adolescents: The Roles of Online Health Information Seeking and Parental Health Anxiety

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Abstract

Health anxiety is a condition which can negatively impact the well-being of an individual through rumination or extreme safety measures. However, literature about the factors related to adolescent health anxiety is scarce. In this study, we explored factors potentially related to adolescent health anxiety. Using structural equation modeling, we analyzed data from 1530 Czech adolescents aged 13–18, recruited through quota sampling, and their caregivers (64% female). First, we focused on its transmission from caregiver to offspring and on the moderating effect of gender. Second, we studied the relationship between online health information seeking and adolescent health anxiety with eHealth literacy as a potential moderator. The responses partially supported our hypotheses. Adolescent health anxiety was positively related to the health anxiety of the caregiver. Disease information seeking was positively related to health anxiety, but we found no such effect for fitness information seeking. Finally, eHealth literacy did not moderate online health information seeking. Our results underline that the health anxiety of caregivers and their offspring are intertwined and should ideally be addressed together. Furthermore, we show that for adolescents, like adults, online disease information seeking can be related to health anxiety and should be considered.

Keywords Adolescence · Health anxiety · Online health information seeking · Parent child relationship · eHealth literacy

Highlights

- Adolescent health anxiety was positively related to parent health anxiety.
- Neither the parent's nor the offspring's gender moderated the relationship between adolescent and parental health anxiety.
- Seeking disease, but not fitness information online was related to health anxiety.
- eHealth literacy did not moderate the relationship between seeking health information online and health anxiety.

Health Anxiety in Adolescents

Health anxiety is defined as distress or fear related to one's body. It represents excessive rumination about illness, misinterpretation of bodily sensations as symptoms of a severe condition, and reporting symptoms without adequate physical pathology. People with health anxiety may overestimate the likelihood of contracting a serious disease or the possible consequences of their current condition (Baumgartner & Hartmann, 2011; Rask et al., 2016). A severe form of health anxiety that interferes with an individual´s functioning is represented in the DSM-5 as Illness Anxiety Disorder or Somatic Symptom Disorder (American Psychiatric Association, 2013).

Until recently, psychologists perceived health anxiety as an adult phenomenon (Wright et al., 2017). However, in Sirri et al. (2015), around 16% of randomly sampled high school students aged 14 to 19 fitted the criteria for clinical-level health anxiety, not including those who may have experienced health anxiety at a subclinical level. Adolescents with increased health anxiety seem to differ from their peers on various levels. Not only are they more preoccupied

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with bodily symptoms, but their focus on the body is connected to increased stress and emotional problems (Rask et al., 2016). On a behavioral level, this may lead to the overuse of medical care, which makes health anxiety costly for society (Fink et al., 2010; American Psychiatric Association, 2013).

During pandemics, such as the outbreak of COVID-19, the features of health anxiety were intensified. Adolescents were familiar with information about the disease's risks and the symptoms one should check (Asmundson & Taylor, 2020). According to the researchers, the recommended safety measures aligned with those suggested for people with health anxiety. However, during a pandemic, they may have protected themselves in more extreme and maladaptive ways, such as completely isolating themselves at home and over-spending on sanitizers.

The effect of health anxiety on adolescents does not seem to be marginal. Nevertheless, its origins and potential amplifiers remain understudied. Research has shown that adolescent health anxiety is related to the health anxiety of their parents and the adolescent's or their family's history of illness (Wright et al., 2017). However, research on adolescent health anxiety outside the context of the primary family is lacking. We aim to bridge this gap by studying the relationship between online health information seeking and health anxiety, which has been studied in adults (Starcevic & Berle, 2013). We also aim to explore both relationships by studying their possible moderators, namely parent and adolescent gender in the transmission of anxiety and eHealth literacy as a moderator for online health information seeking.

Health Anxiety in the Family

Like other mental disorders, health anxiety may be transmitted from parents to offspring (Wright et al., 2017). Observing parental reactions to a potential disease may present one mechanism of this transmission, as parental behavior can shape future offspring responses (Haig-Ferguson et al., 2021). The way parents react to the health-related worries of their offspring determines the ability of their offspring to rethink their own behavior. For parents who worry themselves, reassuring and supporting their offspring´s coping may present a substantial challenge (Fink et al., 2004). Parents with health anxiety are more mindful of potential symptoms in their children than both ill and healthy parents with low health anxiety, and they also seek medical care for their children more (Thorgaard et al., 2017). Such behavior could contribute to future health anxiety because it appears to stem from experience with one's or a significant other's condition (Haig-Ferguson et al., 2021; Wright & Asmundson, 2003).

Although the roles of parental health anxiety and health status (Alberts & Hadjistavropoulos, 2014) are relatively well-studied, little is known about other factors that might influence the transgenerational transmission of health anxiety. Therefore, we derive our assumptions from other anxiety disorders, as the category is often handled together and appears to share common factors that affect transmission (e.g., Bögels & Brechman-Toussaint, 2006; Lawrence et al., 2019). The interplay of the adolescent and the parent gender, which has been studied within anxiety disorders but never specifically for health anxiety, presents such a factor.

The Role of Gender in Health Anxiety

Studies have suggested that females are generally more prone to anxiety disorders (Eley & Gregory, 2004) and health anxiety specifically (Özdin & Bayrak Özdin, 2020). This gender difference was already present in early adolescents, which could be attributable to bodily changes connected with puberty, which have an earlier onset in girls, and their interplay with emotional reactivity (Rask et al. 2016). Rimvall et al. (2021) supported this finding and its stability throughout adolescence from a longitudinal point of view. The researchers reported that, over time, gender remained an important predictor for health anxiety, even when other factors, such as health anxiety at a younger age or a history of chronic illness, were controlled for (Rimvall et al., 2021).

Adolescent Gender as a Moderator

Given the association between gender and health anxiety, it is likely that gender differences may also moderate the process of the transmission of health anxiety in the family system. Ranney et al. (2021) studied the effect of parental anxiety (i.e., the level of anxiety of each parent at the offspring's age of 7, then the change of each parent's anxiety over time) on the general anxiety of their offspring at the age of 15. The general anxiety in girls was related to anxiety reported by both parents and was affected by both parents' anxiety in the past and its change over time. On the other hand, only the father's anxiety at the boy's age of 7 and the mother's change of anxiety were related to anxiety in boys. In other words, anxiety in girls was more significantly affected by the general anxiety history of their parents (Ranney et al., 2021). According to the researchers, this may have been due to different parenting styles, beginning with the fact that girls are often encouraged to express emotions and empathy, while boys are encouraged to be less emotional.

Similar findings can be found in Graham and Weems (2015), who studied anxiety sensitivity, i.e., increased sensitivity to potential anxiety symptoms, which is

considered a central factor of health anxiety (Fergus & Bardeen, 2013). Graham and Weems (2015) found a positive relationship between parent anxiety sensitivity and offspring anxiety sensitivity for girls. For boys, there was a negative relationship; that is, the more anxious the parent, the less anxious the son. Such results suggest that anxiety disorders are more common in girls and more likely to be transmitted to a daughter than to a son. While the relationship seems to vary between zero and negative for sons, it appears to be consistently positive for girls.

Parent Gender as a Moderator

Similarly, gender difference in parents may be associated to how likely they are to transmit their anxiety to their offspring. Again, little is known about the unique effects of both parents' health anxiety on the child, and the information has to be derived from other anxiety disorders. Traditionally, research has focused on the role of the mother's anxiety (Bögels et al., 2008), likely since fathers are often underrepresented or completely missing in studies about the transmission of anxiety (Kerns et al., 2011; Graham and Weems, 2015). That may suggest more significant involvement of mothers in child rearing compared to the possibly more distant fathers, especially in early childhood (Moon & Hoffman, 2008). Such proximity would mean that the more involved parent can influence the offspring directly and intensely.

When the effects of both parents' anxiety are studied together, the results become less straightforward. Previous research has found evidence for the transmission of anxiety from both parents but pointed out that the mechanism for the transmission may differ. Anxious mothers appear to be more controlling than non-anxious ones (Stuart Parrigon & Kerns, 2016). At the same time, their anxiety does not seem to impact other parenting beaviors such as child rearing, co-parenting, and conversational dominance (Bögels et al., 2008). On the other hand, fathers with anxiety are more likely than non-anxious ones to be controlling and rejecting and to take over the conversation in a family interaction (Bögels et al., 2008). Their anxiety also seems to impact security (or rejection) within the father-child relationship (Stuart Parrigon & Kerns, 2016). Their parenting also seems to influence the parenting of their female partners, who appear to be borderline at being more rejecting than the partners of non-anxious fathers. As a result, fathers' parenting, more than mothers', seemed to be influenced by their anxiety (Bögels et al., 2008).

On the other hand, parental influence also seems to vary through the developmental stages. Ranney et al. (2021) showed that the father's anxiety at the offspring's age of 7 did not predict anxiety in adolescence. In mothers, the relationship was stronger, though only for daughters. However, a change in anxiety over time in both parents predicted anxiety in their adolescent offspring, although the effect was, again, stronger in mothers (Ranney et al., 2021). To summarize, although recent research has shown the critical role of fathers in the transmission of anxiety, the findings still somewhat prioritized the effect of mothers' anxiety.

Effect of Online Health Information Seeking

Apart from family context, seeking health information online appears to be an essential factor related to health anxiety. Generally, people with health anxiety seek online health information more often and for a longer time than non-anxious people (Baumgartner & Hartmann, 2011; Brown et al., 2020). The impact of such searches on their well-being seems to be more serious because they tend to feel more worried and distressed than non-anxious people after engaging with online health information (Baumgartner & Hartmann, 2011; Muse et al., 2012). Starcevic and Berle (2013) suggested a circular model that accentuated this reciprocal relationship and showed how both distressful and reassuring information leads to further seeking. Longitudinal data supported the reciprocity; however, it is not entirely clear whether health anxiety preceded online health information seeking or vice versa (te Poel et al., 2016).

Various studies conceptualized "health information" and its "seeking" in various ways including frequency of searching for any health information (Baumgartner & Hartmann, 2011; Muse et al., 2012), motivations and sources (Lagoe & Atkin, 2015; Muse et al., 2012), and kinds of passive and active behaviors, related to health-related internet use (Baumgartner & Hartmann, 2011; te Poel et al., 2016). On the other hand, the studies mostly did not differentiate between searches focused on diseases and health promotion; or only focused on the first (Muse et al., 2012). Therefore, any possible differences between the various search topics and especially the effect of fitness information on health anxiety remain understudied.

Nevertheless, at least some components of health anxiety are related to fitness-oriented activities, e.g., exercise or dietary concerns. Health anxiety could result from enhanced hypervigilance about the body due to exercise, or it could work as its antecedent (Pugh & Hadjistavropoulos, 2011). Consequently, it might be presumed that health anxiety would be related to seeking information about such activities. Given the reciprocal relationship suggested by Starcevic and Berle (2013), seeking fitness information could be both a result result and a trigger of health anxiety. Also, seeking fitness-related information, like any health-related information, may present a gateway to more concerning or overwhelming content being found by accident (Singh and

Brown, 2014). However, to date, such suggestions lack support in data.

To the best of our knowledge, the study by Singh and Brown (2014) was the only one so far that has studied both online disease information seeking (e.g., symptoms, patient experiences) and online fitness information seeking (e.g., diet, exercise, weight-loss) separately in the context of online health information seeking and health anxiety. According to the researchers, both types of health information seeking were positively related to health anxiety. However, the relationship between disease-related information and health anxiety was considerably stronger than fitness-related information ($r = 0.453$, compared to $r = 0.208$). Still, the findings from Singh and Brown (2014) were somewhat limited by the sample, which mainly consisted of women (around 76%) and psychology students. Therefore, one of the aims of this study is to replicate this finding on a more heterogenous sample:

eHealth Literacy as a Moderator

Online health information seeking relies on eHealth literacy, i.e., skills related to using information sources and technologies in the context of health. To be eHealth-literate is to know how and where to find health information online and assess its quality (Norman & Skinner, 2006). In most cited studies, eHealth literacy is self-reported and assessed by the eHealth Literacy Scale, referred to as eHEALS (Norman & Skinner, 2006). eHealth literacy "serve[d] as an enabler" (p. 10) for online health information seeking before a medical appointment (Wong & Cheung, 2019). This appears to be valid regardless of age, gender, education or socioeconomic status (Wong & Cheung, 2019; Li et al., 2014). Apparently, eHealth literacy affects the frequency of online health information seeking also in adolescents (Chang et al., 2015; Maitz et al., 2020), although their ability to realistically rate their eHealth literacy is questionable (Kuroda et al., 2018; Maitz et al., 2020).

Additionally, eHealth literacy might not only enable online health information seeking but also impact its relationship with health anxiety in a protective way. Two studies, which focused on the long-term consequences of the accident at the Fukushima nuclear power plant, found that better health literacy (Kuroda et al., 2018) and eHealth literacy (Nakayama et al., 2019) were associated with lower health anxiety related to the potential consequences of radiation. According to Nakayama et al. (2019), this may have been attributable to differences in various media content and the tendency for more health-literate people to choose sources that may have been more relevant and addressed local concerns, such as government websites and local broadcasts.

Vâjâean and Băban (2015) supported the appeasing role of eHealth literacy. As mentioned, the relationship between online health information seeking and the consequent health anxiety is explained by increased emotional distress (Starcevic & Berle, 2013). Vâjâean and Băban (2015) showed that eHealth literacy (measured by eHEALS) could mitigate the increase in emotional distress related to online health information seeking and serve as a protective factor. Because emotional distress appears to explain health anxiety after online health information seeking, if eHealth literacy can prevent the increase of emotional distress, it may also mitigate the increase of health anxiety. To our best knowledge, this is the first paper to test the moderation effect of eHealth literacy on the relationship between online health information seeking and health anxiety in adolescents.

Control Variables

Age, health status, and time spent online were chosen as control predictors. It appears that age is unrelated to health anxiety throughout developmental stages (O'Bryan et al., 2017; Wright & Asmundson, 2003); however, older adolescents seek online health information more often (Park & Kwon, 2018). Self-assessed health status, on the other hand, is negatively associated with health anxiety (Alberts & Hadjistavropoulos, 2014; Rask et al., 2016) (i.e., the less healthy one feels, the more they are likely to be health anxious). Time spent online is positively related to health anxiety (Singh & Brown, 2014). However, its effect should be explained by online health information seeking when included in the model (ibid).

The Current Study

Adolescent health anxiety appears to be a serious phenomenon with potentially harmful consequences. Still, compared to other anxiety disorders or health anxiety in adults, it remains understudied. While it is known that adolescent health anxiety is related to health anxiety in their parents, the potential factors that could buffer or strengthen the relationship have not been explored. Research has shown that, for anxiety disorders, the gender of both the parent and the offspring can serve as a factor. However, research has also shown that this may vary between respective disorders. To the best of our knowledge, it has never been tested for health anxiety, specifically, and we aim to fill this gap.

Also, adolescent health anxiety has only been studied in the family context; however, this might not be the only source. Research conducted with adults has underlined the

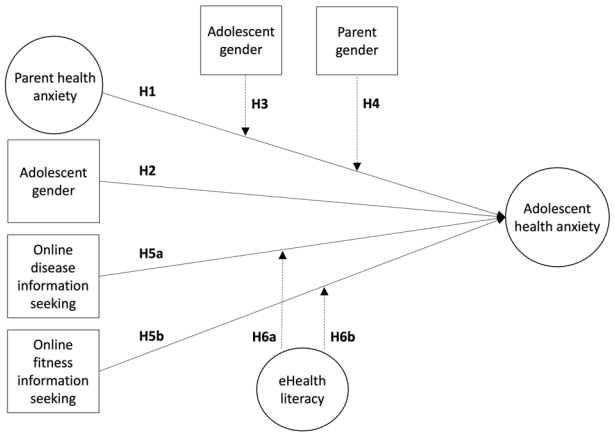

Fig. 1 The conceptual model

effect of online health information seeking on health anxiety, most likely because the internet is one of the most common sources of health-related information. Adolescents are still likely to consult other sources, such as parents. However, given the popularity of the internet among adolescents, we presume that this relationship is relevant and worth exploring. We aim to bridge this gap and test whether online health information seeking is related to adolescent health anxiety, as it is for parents.

This study aims to expand on the limited body of literature about adolescent health anxiety by exploring the factors potentially related to adolescent health anxiety and the variables that may moderate such relationships (for the conceptual model, see Fig. 1). First, we focus on the transmission of health anxiety within the family. We test the following hypotheses:

H1: *Health anxiety in the caregiver is positively associated with health anxiety in adolescents.*

H2: *Being a girl is positively associated with health anxiety in adolescents.*

H3: *The relationship between health anxiety in caregivers and adolescents will be stronger for girls than for boys.*

H4: *The relationship between health anxiety in caregivers and adolescents will be stronger for female caregivers.*

Second, we test the results from Singh and Brown (2014) on a different age group. For the first time, we also explore the possible moderation effect of eHealth literacy on this relationship. We hypothesize the following:

H5a: *Seeking disease information online is positively related to health anxiety in adolescents.*

H5b: *Seeking fitness information online is positively related to health anxiety in adolescents.*

H6a: *eHealth literacy moderates the effect of online disease information seeking on health anxiety in adolescents.*

H6b: *eHealth literacy moderates the effect of online fitness information seeking on health anxiety in adolescents.*

Finally, we control for age, health status, and time spent online.

Method

Our study is based on cross-sectional data collected from adolescents and their caregivers in an anonymous self-administered online survey. Our team hired an external research agency to collect the data. The agency recruited members of their online panel (i.e., caregivers) and their adolescent offspring with quota sampling. Eligible were families that included at least one caregiver and one adolescent willing to fill out the questionnaire, i.e., including, for example, single parents. Adolescents' gender and age were distributed equally. Household income, regions according to NUTS3 (Eurostat, 2020), and the municipality size were distributed to represent Czech households with adolescents. The survey took the adolescent and the parent approximately 25 min to complete. The study was approved by the Research Ethics Committee of the Masaryk University.

Participants

The participants were 1,530 Czech adolescents (50% girls) aged 13–18 ($M = 15.4$, $SD = 1.7$) and their caregivers (64% women) aged 29–75 ($M = 45$, $SD = 6.4$). Given the widely used rules of thumb for SEM-sample-size requirements and the results of simulation studies (e.g., Wolf et al., 2013), we concluded that the current sample size of 1,530 sufficed. We acquired the data in November 2020. The data collection period had some specific limitations due to the COVID-19 pandemic; for instance, adolescents had not been attending school and were being home-schooled. Some caregivers stayed home as well. We required written informed consent from the adolescents and their caregivers before the administration of the survey. We assured the participants of anonymity, and they could have refused their participation before or during the survey.

Measures

Health anxiety

We measured the health anxiety of both adolescents and caregivers with the five items of the Multidimensional Inventory of Hypochondriacal Traits scale (Longley et al., 2005), for example: "When I experience pain, I fear I may be ill" and "I am concerned with the possibility of being

diagnosed with a serious disease". Two items that asked about skin blemishes and death had to be excluded due to the length of the questionnaire. These items were chosen based on their expected difficulty for adolescents, as skin blemishes are common for this age, and death concerns, on the other hand, are rare compared to the other items. The response scale ranged from 1 (Completely untrue) to 5 (Completely true). The internal consistency was adequate among adolescents ($\omega = 0.83$; $M = 2.5$, $SD = 0.9$) and caregivers ($\omega = 0.88$; $M = 2.8$, $SD = 0.9$).

Health information seeking

We created a new measure for the purpose of this study. We captured disease and fitness information seeking by asking: "The following questions focus on information about health. In the past few months, how often have you been using the internet to search for information, discussions, articles, or posts about…". The three items of the disease domain were: "COVID-19,"; "Other diseases, injuries, or their treatment (not about COVID-19),"; and "Medicines or medicinal substances". The three items of the fitness domain were: "Healthy eating and nutrition,"; "How to exercise or do sports (not professional sports),"; and "Losing weight (e.g., diets, weight-loss tutorials)". The response scale ranged from 1 (Never) to 6 (Several times a day). The internal consistency of the disease information-seeking scale ($\omega = 0.80$; $M = 2.3$, $SD = 1$) and the fitness information-seeking scale ($\omega = 0.82$; $M = 2.4$, $SD = 1$) were adequate.

eHealth literacy

We assessed eHealth literacy with six items from the eHealth Literacy Scale (eHEALS) (Norman & Skinner, 2006), for example: "I know where to find helpful resources on the internet" and "I can tell high quality from low-quality health resources on the internet". The response scale ranged from 1 (Strongly disagree) to 5 (Strongly agree). The internal consistency was adequate ($\omega = 0.84$; $M = 3.4$, $SD = 0.7$).

Demographics

We determined gender by the question: "Are you…?" Adolescents replied 1 (Girl) or 2 (Boy), and caregivers answered 1 (Woman) or 2 (Man). A total of 50% of adolescents and 64% of caregivers were female. We determined age by the question "How old are you?" with an open-response format for both adolescents and caregivers; adolescents $M = 15.4$, $SD = 1.7$, caregivers $M = 45$, $SD = 64$.

Time online

We adapted the measure for time online from EU Kids Online (Zlamal et al., 2020) and asked: "About how much time do you spend on the internet during a typical weekday (Monday - Friday)?" The response scale ranged from 1 (Little or no time) to 9 (About 7 hours and more); $M = 6.6$, $SD = 1.8$.

Health status

To assess health status, we asked a single question: "How would you say your overall health has been in the past few months?" This item was adapted from the HBSC Survey (Hunsaker et al., 2021; Inchley et al., n.d.). The response scale ranged from 1 (Poor) to 5 (Excellent); $M = 3.5$, $SD = 0.9$.

Statistical Analysis

The data were analyzed using SEM in Mplus (8th version) (Muthén & Muthén, 2017). We utilized a confirmatory approach to the model testing. The main model (i.e., without interaction effects) consisted of the relationship between disease and fitness information seeking and adolescents' health anxiety, and caregiver's anxiety and adolescents' health anxiety while controlling for gender, age, health status, and time online. We separately added the moderating effects of eHealth literacy, gender, and caregiver's gender, each time controlling for the main effect of the moderating variable. The interactions were computed via the product-indicator approach, which involves the multiplication of the predictor and the moderator indicators. Therefore, the analysis consisted of four models (i.e., A, B, C, D), as shown in Fig. 1. Because of the non-normal distributions, we used a Robust Maximum Likelihood (MLR) estimator. Adolescent health anxiety, caregiver's health anxiety, and eHealth literacy were treated as latent variables. The latent variables were indicated by the individual items that were treated as continuous. Observed variables were disease information seeking, fitness information seeking, gender, health status, time online, and caregiver's gender and age. The observed variables composed of more than one item (i.e., disease information seeking, fitness information seeking) were indicated by the mean of the relevant indicators. We allowed residual correlations between several items of health anxiety (i.e., "I worry a lot about my health" — as related to — "When I experience pain, I fear I may be ill"; "I am concerned with the possibility of being diagnosed with a serious disease" — as related to — "I worry about the physical problems of getting older"); caregiver's health anxiety (i.e., "I am concerned with the possibility of being

Table 1 The effects of variables on health anxiety

	B	CI	*b*	*p*
Parental health anxiety	0.40	0.36; 0.45	0.48	<0.001
Disease information	0.23	0.18; 0.29	0.27	<0.001
Fitness information	0.08	0.02; 0.13	0.09	0.02
Gender	−0.11	−0.15; −0.06	−0.25	<0.001
Age	−0.07	−0.11; −0.03	−0.08	0.01
Health status	−0.12	−0.17; −0.08	−0.15	<0.001
Internet use	0.02	−0.03; 0.06	0.01	0.52

diagnosed with a serious disease" — as related to — "I worry about the physical problems of getting older"); and eHealth literacy items (i.e., "I know what health resources are available on the internet" — as related to — "I know where to find helpful health resources on the internet"; "I have the skills I need to evaluate the health resources I find on the internet" — as related to — "I can tell high-quality health resources from low-quality health resources on the internet"). We evaluated the model fit with the widely used criteria by Hu and Bentler (1999).

Results

The model fit the data adequately, CFI = 0.94, TLI = 0.93, RMSEA = 0.06, $_{95}$[0.05; 0.06], SRMR = 0.05. We display the results in Table 1. Caregiver's health anxiety was positively related to adolescents' health anxiety ($\beta = 0.40$, $p < 0.001$), meaning that increased health anxiety among caregivers was associated with increased health anxiety among their offspring, and vice versa (H1). Disease (H5a; $\beta = 0.23$, $p < 0.001$) and fitness (H5b; $\beta = 0.08$, $p = 0.02$) information seeking were positively associated with adolescents' health anxiety; however, the effect of fitness information seeking was negligible. Health anxiety was further slightly connected with gender ($\beta = -0.11$, $p < 0.001$), showing that girls experienced higher levels of health anxiety than boys (H2). Health status was negatively associated with health anxiety ($\beta = -0.12$, $p < 0.001$), indicating that adolescents with poorer health status experienced increased health anxiety. The effect of age emerged ($\beta = -0.07$, $p = 0.01$), but it was too weak to be considered practically significant.

We also examined the moderating effects of eHealth literacy (Model C and D), adolescent gender (Model A), and the caregiver's gender (Model B). eHealth literacy was presumed to moderate the connection between health (disease and fitness) information seeking and adolescents' health anxiety. Adolescent and caregiver's gender were expected to moderate the association between caregiver and adolescent health anxiety.

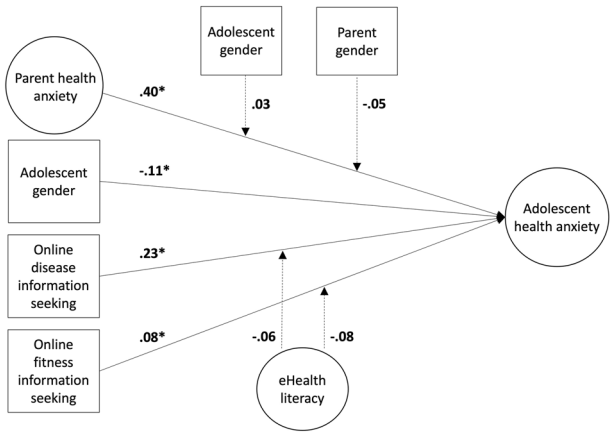

Fig. 2 The conceptual model, with results

Nonetheless, these moderations did not emerge; eHealth literacy did not significantly moderate the effect of disease (H6a; $b = -0.06$, $p = 0.14$) and fitness (H6b; $b = -0.08$, $p = 0.06$) information seeking on adolescents' health anxiety. The moderation of the effect of fitness information seeking approached significance, but due to the large sample size utilized in this study, we did not interpret the finding as substantial. Regarding the moderating roles of gender, neither the adolescent's (H3; $b = 0.03$, $p = 0.71$) nor the caregiver's (H4; $b = -0.05$, $p = 0.51$) gender moderated the association between the caregiver's health anxiety and adolescents' health anxiety. For the summary of all of the results, see Fig. 2.

Discussion

This paper aimed to study adolescent health anxiety in light of the health anxiety of their caregivers and adolescents' online health information seeking. We expected a positive relationship between caregivers' and adolescent health anxiety (H1) and between the female gender and health anxiety (H2). We posited that the relationship between caregiver and adolescent health anxiety would be moderated by the gender of both (H3 and H4). We tested a positive relationship between disease- and fitness-related health information seeking and adolescent health anxiety (H5), which we expected to be moderated by eHealth literacy (H6). Our findings support some of these expectations. However, for some hypotheses, we were not able to find support.

Effect of Caregivers´ Health Anxiety

In line with H1, the caregiver's and adolescent health anxiety levels were significantly related. Earlier, we mentioned that this relationship had been relatively well studied

in the otherwise understudied area of adolescent health anxiety (Wright et al., 2017). Our study adds to this literature by underlining the importance of caregiver's health anxiety, even within the broader context of explanatory variables. Although not the only factor related to adolescent health anxiety, caregiver health anxiety presents the strongest one in our model. This finding underlines the significance of the relationship between the caregiver's and adolescent health anxiety, even after considering its other potential triggers.

Gender Effects on Adolescent Health Anxiety

Being a girl was positively associated with health anxiety, which supports H2. This aligns with the general trend of anxiety disorders, which are more common for females than males (Eley & Gregory, 2004; Özdin & Bayrak Özdin, 2020). It is also in line with literature about health anxiety, specifically where studies show that adolescent girls are supposed to be more conscious of their bodily changes than boys and, therefore, more health anxious (Rask et al., 2016). Still, our study shows that this relationship is relatively weak when the effects of the caregiver's health anxiety, seeking online health information, and health status are accounted for. Therefore, while our data support the general trend, they also show that health anxiety is by no means a predominantly female phenomenon, and it should not be approached as such.

On the other hand, the relationship between caregiver and adolescent health anxiety was not moderated by either the adolescent or the caregiver's gender, which is contrary to our expectations. Our data did not support H3 because the relationship between caregiver's health anxiety and adolescent health anxiety did not differ for girls and boys. There are two possible explanations for this finding. First, such a moderation effect may not exist. Second, the adolescent's gender may play some role in the transmission. However, rather than moderating the caregiver-adolescent anxiety transmission, generally, adolescent gender may determine whether anxiety will be related to the mother's or the father's health anxiety separately. The transmission of anxiety disorders appears to be more limited in boys, whose level of anxiety is only related to that of the mother, while girls' anxiety is linked to the level of both caregivers (Landman-Peeters et al., 2008; Ranney et al., 2021). Therefore, we cannot rule out the possibility that our results did not support our hypothesis because they are confounded by not accounting for same- and opposite-gender dyads. Future studies should focus on explaining the effect of gender on health anxiety transmission using data from both caregivers.

Also, contrary to H4, the relationship between caregiver and adolescent health anxiety was not stronger in the mother-adolescent dyad compared to the father-adolescent dyad. Although it was reasonable to expect that mothers were more related to their offspring in anxiety disorders than their fathers, a substantial body of literature also says otherwise. This relationship may also change with the increasing involvement of fathers in parenting. In 2001, McClure et al. included both parents in their study and found only a link for anxiety between the mother and 15-year-old offspring. In 2016, Stuart Parrigon and Kerns showed comparable effects for both parents. In conclusion, we believe that the relationship between caregiver and adolescent health anxiety does not differ in magnitude for mothers and fathers.

Nonetheless, there may be a difference between mothers and fathers, but it is of qualitative nature (i.e., the parenting areas that are affected by their anxiety disorders and through which they can enhance anxiety disorders in their offspring; Bögels et al., 2008). They may also differ in which anxiety disorder impacts their parenting – which cannot be recognized when anxiety disorders are handled as one concept. For example, in Möller et al. (2015), general anxiety disorder affected the parenting skills of the mothers of infants, while social anxiety disorder did not – and the opposite was true for fathers. Anxiety disorders may differ in gender effects, and it might be useful to study them separately rather than as a group. Also, future studies should explore whether and in what areas of parenting health anxiety affects mothers and fathers and how it can be related to adolescent health anxiety.

Last but not least, it is possible that the cultural family setting may play a role in the differences in the transmission. As noted above, the distribution of parental tasks may change over time. Besides, it may differ for various custody arrangements for divorced families, same-sex families, or single parents. In the latter, tasks are similar for a single mother and a single father, which implies that their ways of parenting do not differ much (Dufur et al., 2010). While the area of anxiety transmission in various family settings remains understudied, it is reasonable to expect that there are differences. Similarly, all of the cited studies, as well as our study, analyze data from Euro-American countries, which prevents generalization for other regions with potentially different patterns of mothering and fathering.

Online Health Information Seeking and Adolescent Health Anxiety

We further focused on online health information seeking, which is positively related to adult health anxiety in adults (Starcevic & Berle, 2013). We split the information sought online into disease- and fitness-related categories, which have only rarely been tested (apparently only in Singh & Brown (2014), although the effect of both kinds of

information on health anxiety has been debated (Pugh & Hadjistavropoulos, 2011; te Poel et al., 2016) and can be useful to study separately. Our study is the first to examine the effect of online health information on adolescent health anxiety and test both disease- and fitness-related information seeking separately on such a sample.

In line with H5a, online disease information seeking was significantly related to health anxiety. This finding implies that the interconnectedness of online health information seeking and health anxiety (often dubbed cyberchondria) is no less relevant for adolescents than adults (Starcevic & Berle, 2013). However, seeking fitness-related information was practically unrelated to adolescent health anxiety, contrary to H5b. Seeking fitness information is supposed to enhance health anxiety by finding more concerning content (te Poel et al., 2016). Still, even in adult literature, this remains an untested claim. Moreover, adolescents and adults may differ in their motivation for online fitness information seeking and, therefore, also in their search patterns. Our findings suggest that this process is unrelated to health anxiety in adolescence. Furthermore, the difference between disease and fitness information seeking suggests that it is reasonable to assess them separately, although they are often handled as one concept.

Moderating Effect of eHealth Literacy

Finally, we assumed that eHealth literacy would moderate the relationship between online health information seeking (both for disease and fitness) and health anxiety. However, such a moderation effect was not supported, which leads us to reject H6 with several possible explanations. First, such a moderation effect may not exist. Second, the effect may not be detectable due to the choice of methods, namely the self-reported eHealth Literacy Scale (Norman & Skinner, 2006). While this scale presents a standard measure for assessing eHealth literacy, some authors have pointed out that its correlation with performance on eHealth-related tasks is weak (van der Vaart et al. (2011); Maitz et al., 2020). On the other hand, it seems to be conceptually close to self-efficacy (Maitz et al., 2020). Therefore, using this measure, we might not have been able to show the role of eHealth literacy in evaluating online health information. Third, while sources rated as more reliable (such as local or public broadcasts) tended to be more comforting in some studies (Kuroda et al., 2018; Nakayama et al., 2019), this does not always have to be the case. In pandemics such as COVID-19, it might be the reliable media that broadcasts distressful information (or may even interpret the situation slightly more dramatically to prompt people to protect themselves; Trnka & Lorencova, 2020). Either way, it does not seem that increasing eHealth literacy would help reduce the relationship between online health information seeking and health anxiety in adolescents.

Limitations

Several limitations should be considered when interpreting this study's results. First, our data are cross-sectional, which makes it impossible to infer causal relations other than those based on literature. Nevertheless, it appears that the relationship between caregiver and adolescent anxiety and online health information seeking and health anxiety can be interpreted in both ways or even in a reciprocal way. Our findings regarding caregiver-adolescent relationships are somewhat limited by our sample. We did not obtain data from both caregivers. The decision whether the mother or father would fill out the questionnaire was left to each family. Due to this self-selection, various caregiver-adolescent dyads were not randomly assigned or equally represented. That makes it impossible to compare whether the transfer of health anxiety is more significant in one caregiver's gender than in the other. Moreover, we did not consider the family structure and cannot rule out potential differences for divorced, same-sex, or single parents.

Finally, COVID-19 is likely to have impacted the study. The data were collected in November 2020, during one of the pandemic waves. The situation may have increased health anxiety in the population and impacted other factors in this study. Therefore, the findings from this study should be further tested in a post-pandemic setting.

Conclusions and Practical Implications

This study tested two types of factors that are potentially related to adolescent health anxiety. First, we showed that, like in other anxiety disorders, the levels of health anxiety in adolescents and their caregivers are related to each other. We tested whether this relationship is moderated by the caregiver or adolescent gender. However, we did not find support for this claim, and, at the same time, we cannot reject it with confidence due to the nature of our study. Second, we found support for the relationship between disease-related online health information seeking and health anxiety known in adults. However, unlike adults, adolescent fitness-related seeking appears unrelated to health anxiety. Also, the relationship between online health information seeking and health anxiety appears fully independent of the eHealth literacy of the seeker.

Several practical implications can be concluded from our findings. First, although it is often emphasized that anxiety disorders are more common in girls, health anxiety should not be limited to being a female phenomenon. Practitioners should expect its occurrence in both genders, albeit slightly more often in girls. Second, research has shown that, to

date, there is no intervention focused on reducing health anxiety in adolescents (Haig-Ferguson et al., 2021). Haig-Ferguson et al. (2021) suggest adapting CBT programs for adults' health anxiety. They also suggest that caregivers should be involved in the intervention as a reassuring element (Haig-Ferguson et al., 2021). Our results suggest that this should not be their only role. Due to the intertwined relationship between the health anxiety of the caregiver and offspring, we strongly recommend that future interventions should also focus on the caregiver's health anxiety. However, to design an effective intervention, future research is needed to explore the mechanism of the transmission of health anxiety between the caregiver and the offspring (which potentially leads both ways). Third, we, for the first time, showed that adolescent health anxiety is related to seeking disease information online. We also found that the level of eHealth literacy does not mitigate such a relationship. Similar to adults, future research and interventions should consider the online activities of adolescents with health anxiety. Also, caregivers should actively intervene by monitoring the search process and discussing the information with their offspring.

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Compliance with Ethical Standards

Conflict of Interest The authors declare no competing interests.

Ethical Approval and Informed Consent All procedures in the current study were approved by the institutional review board, the Research Ethics Committee of the Masaryk University. Informed consent was obtained from all caregivers and adolescents participating in the study.

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