Adolescents' Use of Sexually Explicit Internet Material Over the Course of 2019–2020 in the Context of the COVID-19 Pandemic: A Three-wave Panel Study

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Abstract

Recently, sexual health scholars have expressed concerns regarding adolescents' use of sexually explicit internet materials (SEIM) during the COVID-19 pandemic. Therefore, using latent growth curve modeling, the current study explored adolescents' changes in the frequency of SEIM use before, during, and after a strict lockdown period was established in Belgium. Attention was given to individual differences (i.e., gender, gender identity, sexual orientation, pubertal timing, and sensation seeking). A three-wave panel study over a 15-month period among 522 adolescents was used ($M_{\text{age}} = 15.36$, $SD = 1.51$, 67.1% girls). In general, SEIM use did not significantly increase over a 15-month period in the context of the COVID-19 pandemic. Only gender predicted a change in SEIM use frequencies with girls showing a greater, increasing change of SEIM use than boys. When addressing why adolescents used SEIM during a strict lockdown period, sexual arousal, stress, and boredom regulation motivations emerged as the most prevalent motivations. Loneliness regulation was the least prominent motivation. Individual differences were found regarding the gratifications sought according to adolescents' gender, pubertal timing, and sensation seeking. The findings offer a response to sexual scholars' worries in terms of adolescents' SEIM use during the COVID-19 pandemic.

Keywords Pornography · Adolescents · COVID-19 · Latent Growth Modeling

Introduction

Scholars consider adolescents' use of sexually explicit internet materials (SEIM) as a normative part of adolescents' sexuality construction (Sabina et al., 2008). With the recent spreading of the COVID-19 virus, the developmental context in which adolescents consumed SEIM drastically changed (Clemens et al., 2020; Gupta & Jawanda, 2020; Orben et al., 2020). Social distancing measures dependent on the status of contamination of the virus (WHO, 2020) limited offline sexual explorative behaviors with (potential) romantic partners and, simultaneously, triggered feelings of boredom, loneliness, and stress (Common Sense Media, 2020; Francisco et al., 2020).

Building on existing literature on motivations of adolescents' SEIM uses (Löfgren-Mårtenson & Månsson, 2010), recent reports have warned that the changed social context in periods of strict measures may have stimulated SEIM use in adolescents as a response to developmental disruptions and deteriorated moods (Döring, 2020). Following such presumptions, the current study first examined whether there was an increase in Belgian adolescents' frequencies of SEIM use throughout 2019–2020 in the context of the COVID-19 pandemic (H1). If an increase in SEIM use has occurred during the pandemic, more attention to the effects of SEIM use may be needed (Döring, 2020).

During the strict lockdown period, changes in adolescents' SEIM use may have especially occurred in groups of adolescents of which prior research has suggested they are more prone to have an increase in their usage trajectory (e.g., Baumgartner et al., 2012). As such, the current study further hypothesized that gender, gender identity, sexual orientation, pubertal timing, and sensation seeking predicted the trend in Belgian adolescents' frequencies of SEIM use throughout 2019–2020 in the context of the COVID-19 pandemic (H2).

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Such insights help to identify groups of users that show an increased risk of a high use trajectory (Peter & Valkenburg, 2016).

Lastly, a gratifications framework (Katz et al., 1974) was applied to understand why adolescents consumed SEIM during a strict lockdown period. The changed social context makes it particularly interesting to understand which reasons drove adolescents' SEIM use during a strict lockdown period (RQ1). Not all gratifications sought hint at healthy sexuality (e.g., stress regulation) (Paul & Shim, 2008). Understanding which gratifications drove adolescents' SEIM use during a strict lockdown period helps to contextualize the use of SEIM and its potential effects. When addressing these different gratifications sought, the heterogeneous nature of the sample (i.e., gender, gender identity, sexual orientation, pubertal timing, and sensation seeking levels) was accounted for (RQ2).

Adolescents' Sexually Explicit Internet Material Use

Adolescent sexuality development marks a period of self-discovery (Kar et al., 2015). Particularly, the interplay between biological and psychosocial changes stimulates adolescents' formation of their sexuality (Fortenberry, 2013a). In the literature, sexuality is referred to as an inclusive category encompassing how adolescents describe, feel, or express their sexual selves (Diamond & Savin-Williams, 2009). Adolescents' exploration of their sexuality spans a range of behaviors within the personal and interpersonal context (e.g., romantic relationships and talk about sex with peers) (Salerno et al., 2015).

In a personal context, adolescents discover their sexuality through the creation of sexual fantasies, masturbation, and the search for sexually explicit internet materials (SEIM) (Fortenberry, 2013b). Such explicit materials are generally referred to as “professionally produced or user-generated pictures or videos intended to sexually arouse the viewer” (Peter & Valkenburg, 2011, p. 1015–1016). Recent reports on adolescents' uses of SEIM highlight the relative prevalence of this behavior across different countries. Particularly in the USA, 77% of boys and 33% of girls retrospectively reported watching SEIM (Hardy et al., 2019). In Croatia, SEIM use is also highly common among boys (90%) and girls (43%) (Milas et al., 2020). Similar consumption rates as in Croatia were previously found in Belgian adolescents (Maes et al., 2019).

Given their anonymous and accessible nature, SEIM are appealing sexual information sources next to peers and parents (Wright, 2014). The literature has put some critical questions with SEIM's role as a sexual socialization agent given its frequent biased and unrealistic content (e.g., absence of contraceptives, sexual gender stereotypes, sexual objectification of women) (Wright, 2014). Concerns about

such negative effects have sometimes been justified in media effects research (Peter & Valkenburg, 2016). Among the most consistently supported links in the literature are the links of SEIM use with the sexual objectification of women and adolescents' engagement in risky sexual behavior (Peter & Valkenburg, 2016). Moreover, some groups of adolescents are more susceptible to these negative outcomes than others (e.g., in male samples the link between SEIM use and no condom use is significant but not in female samples; Luder et al., 2011). It should also be noted that prior research has had an exclusive focus on negative effects of SEIM use. Yet, potential positive effects of SEIM use may also be expected, such as shared SEIM use among romantic couples increasing communication between partners (Kohut et al., 2018). However, to our knowledge, research is lacking on these potential positive effects of adolescents' SEIM use.

Adolescents' Sexually Explicit Internet Material Uses During the COVID-19 Pandemic

With the rise of the COVID-19 pandemic, the context in which adolescents used SEIM was drastically affected (Döring, 2020; Mestre-Bach et al., 2020). This was especially true during a strict lockdown period, operative in Belgium and some other countries like the UK from March until the middle of May in 2020. In such a period, strict physical distancing measures were established to reduce the further spreading of the virus (WHO, 2020). For instance, in Belgium, individuals were unable to meet other people outside of their households. Further, schools were closed and educational curriculums were taught online. Some classes were given synchronously (e.g., teaching in real time), while other classes were given asynchronously (e.g., learning at one's own pace via online assignments). Stores (besides supermarkets and pharmacies) were closed and non-essential transportations were prohibited. This strict lockdown period severely disrupted adolescents' social context and, therefore, their abilities to explore emerging sexual feelings via intimate, physical contact (Gupta & Jawanda, 2020).

After the strict lockdown period, an “exit strategy” (i.e., gradual shift toward less restrictive measures) was operative from the middle of May in Belgium and several other countries (e.g., the UK). Individuals in Belgium, for instance, were prohibited to have any form of personal physical contact with people outside their so-called social bubble (i.e., ranging from 2 to 15 people, dependent on the status of COVID-19 spreading). Moreover, physical distancing measures (e.g., keeping a distance of 1.5 m from individuals) were operative in all periods following the crisis. In schools, school attendance varied with some classes being taught in person, and other classes being taught online, at home (i.e., synchronously or asynchronously). Although such measures were perceived as less intense in the less strict period, adolescents'

social (romantic) environment was still considered highly disrupted (e.g., Clemens et al., 2020; Gupta & Jawanda, 2020; Majeed & Ashraf, 2020).

According to sexual health scholars, these changes in the social environment presumably created a context in which *some* adolescents have been more prone to masturbate and, therefore, probably also have used more SEIM (Döring, 2020; Mestre-Bach et al., 2020; Perissini et al., 2020). More precisely, scholars highlight that some groups of adolescents were more affected by the negative consequences of the COVID-19 pandemic than others and, therefore, may have turned more easily to online tools to cope with these consequences. For example, Fish et al. (2020) demonstrated that LGBTQ but not heterosexual youth were experiencing identity-specific stressors as a result of the pandemic. Adolescents voiced concerns about being confined at home with unsupportive family members and the inability to access support resources. In this way, the literature suggests that LGBTQ turned to virtual spaces, such as SEIM, to further explore their sexual and gender identity.

Not only was the context of social distancing likely to have stimulated adolescents' SEIM uses, but it probably also facilitated such uses. Perissini et al. (2020) point to changes in the learning environment (i.e., from offline in school to online asynchronous and synchronous classes at home) and parents who work from home and, therefore, pay less attention to what their children are doing. These at-home changes allowed adolescents to more easily and more frequently access SEIM without being interrupted.

Some first findings seem to suggest SEIM use has increased during the strict lockdown period. Particularly, the popular SEIM platform Pornhub has noted a worldwide increase in pornography use of 11.6% during a period in which social distancing measures were the most strict (Pornhub, 2020). The literature speculates that similar evolutions have taken place among adolescents (Perissini et al., 2020). As such, the current study hypothesizes that there was an increase in Belgian adolescents' frequencies of SEIM use throughout 2019–2020 in the context of the COVID-19 pandemic (H1).

When addressing the possible evolution in adolescents' SEIM uses, some groups of adolescents may have been more prone to develop an increasing SEIM use trajectory (Döring, 2020). Existing literature posits that gender, gender identity, sexual orientation, pubertal timing, and sensation seeking levels predict differences in adolescents' trajectory of SEIM use (e.g., Baumgartner et al., 2012). Retrospective research examining growth trajectories in adolescents' SEIM use showed a stronger increase among boys than girls throughout adolescence (Rasmussen & Bierman, 2016). This gender difference can be explained by the discourse that watching SEIM is an inherently "masculine" behavior (e.g., Scarcelli, 2015). Following sexual double standards, sexual pleasure

and agency are considered to characterize male sexuality (Murray, 2018). Women and girls are supposed to be less preoccupied with gratifying their sexual pleasure (Fahs, 2014; Ponton & Judice, 2004). Mainstream SEIM are further typically created for male viewers, given the almost consistent focus on the male sexual gaze (Bridges et al., 2010).

Relatedly, SEIM use may also be dependent on the extent to which adolescents understand themselves in relation to culturally feminine and masculine meanings attached to being a man or a woman (Wood & Eagly, 2012). One of the few studies that examined gender identification in terms of adolescents' SEIM use found that hyper-feminine girls were more likely to initiate watching SEIM, while hyper-masculinity played no significant role in boys' initiation of watching SEIM (Vandenbosch & Peter, 2016). Potentially, the gender stereotypical content that is mainly portrayed in SEIM, aligns with sexual attitudes of girls who identify as feminine but not with sexual attitudes of girls who identify themselves less as "feminine." For boys, a higher identification with masculinity may be less relevant to explain why adolescents watch SEIM (Vandenbosch & Peter, 2016). In terms of SEIM use trajectories and adolescents' gender identity, research is lacking (Böthe et al., 2019).

Further, the recent review of Böthe et al. (2019) points at sexual orientation differences in terms of adolescents' SEIM uses. Of the little research that has paid attention to non-heterosexual adolescents' SEIM use frequencies, contradictory results have emerged. Some studies demonstrated no significant differences when heterosexual and non-heterosexual adolescents were retrospectively questioned about their SEIM use (Vandenbosch & van Oosten, 2018), while other studies reported that pornography use among non-heterosexual adolescents was three times more frequent than among heterosexual adolescents (Lim et al., 2017; Peter & Valkenburg, 2011). To our knowledge, no existing research has studied SEIM use trajectories of heterosexual adolescents relative to non-heterosexual adolescents.

Another relevant indicator of adolescents' trajectories in SEIM is adolescents' pubertal timing. The recent retrospective study of Nieh and colleagues (2020) demonstrated that among girls, early pubertal timing was an indicator of a steeper increase in SEIM use. Other research is lacking. Lastly, sensation seeking, which is "a need for varied, novel and complex sensations and experiences, and the willingness to take physical and social risks for the sake of such experiences" (Zuckerman, 1979, p. 10), has retrospectively been related to a steeper rate of increase in SEIM use (e.g., Peter & Valkenburg, 2011). Given that sexual activities such as SEIM use trigger novel and complex sensations, adolescents who are more prone to seeking sensations use SEIM more often (Beyens et al., 2015).

Following these previous findings on individual differences in adolescents' SEIM use, this article argues that

gender, gender identity, sexual orientation, pubertal timing, and sensation seeking will predict the increase in Belgian adolescents' frequencies of SEIM use throughout 2019–2020 in the context of the COVID-19 pandemic (H2).

Contextualizing Adolescents' Sexually Explicit Internet Material Uses During a Strict Lockdown Period

Adolescents' SEIM use during strict social distancing can be understood by examining the motivations for this particular online behavior in this unique period. Specifically, uses and gratifications theory (U&G) (Katz et al., 1974) postulates that users' motivations for particular media types have implications for how a user consumes a medium (Rubin, 1983). These motivations are referred to as “gratifications sought” and capture one's intention to use media based on the expectations of the outcomes of this usage, such as expecting sexual satisfaction after watching SEIM.

Existing studies distinguished four main motivators of adolescents' SEIM uses (Bóthe et al., 2021; Grubbs et al., 2019). Particularly, some studies reported adolescents used SEIM to (1) gratify their growing sexual curiosity and explore their sexual selves (Chen et al., 2013; Ševčíková & Daneback, 2014), (2) gain information about sexual activities in general (Chen et al., 2013), (3) gratify themselves sexually (Chen et al., 2013; Mattebo et al., 2014), and (4) to avoid boredom, relieve stress, and combat loneliness (e.g., Chen et al., 2013).

Given the changed social context during the strict lockdown period, it may be possible that different motivations of SEIM use among adolescents were more prevalent (Döring, 2020; Mestre-Bach et al., 2020; Perissini et al., 2020). Particularly, adolescents' inability to explore their sexual selves and gratify emerging sexual interest and arousal within intimate, physical relationships may have triggered SEIM use. Moreover, recent reports documenting adolescents' experiences during the COVID-19 crisis point to the prevalence of stress, loneliness, and boredom (Common Sense Media, 2020). Possibly, adolescents thus turned to SEIM to regulate such emotional responses and moods. As some motivations can be considered part of normative sexual behaviors (e.g., exploring one's sexuality) (Paul & Shim, 2008) and others are assumed to be less desirable (e.g., stress regulation) (Esplin et al., 2021), it seems useful to further contextualize adolescents' SEIM use during a strict lockdown period. As such, the current study examined:

RQ1: Which gratifications sought were the most prevalent motivations of adolescents' SEIM uses during a strict lockdown period?

Scholars have further underlined the relevance of individual differences in motivations of SEIM uses (Bóthe et al.,

2021). As for gender, boys have consistently reported sexual arousal as the most common reason for SEIM use, whereas girls typically point to curiosity as the main reason to use SEIM (e.g., Wallmyr & Welin, 2006). When it comes to the extent to which adolescents identify as “masculine” or “feminine,” scholars suggest that SEIM use is more often used to learn about sexual roles. In this way, adolescents learn how “feminine” and “masculine” sexual partners behave when having sexual intercourse (e.g., sexual dominance among males, and sexual passiveness among females) (Bóthe et al., 2019). Also, studies show that non-heterosexual adolescents are primarily motivated to use SEIM to develop and validate their own sexual orientation (Arrington-Sanders et al., 2015; Bradford et al., 2019), though no existing studies have contrasted these motivations with those of heterosexual adolescents. Further, studies have shown that arousal motivators become more prevalent when adolescents mature (e.g., Ševčíková & Daneback, 2014). With regard to sensation seeking, no existing studies have yet explored the differences in reasons to use SEIM according to adolescents' sensation seeking levels. Scholars did argue that some motivators may be more pronounced according to the adolescents' sensation seeking levels (Grubbs et al., 2019).

Building on these documented and assumed individual differences in adolescents' SEIM uses (e.g., Ševčíková & Daneback, 2014), similar differences may occur with regard to adolescents' SEIM motivations during the COVID-19 strict lockdown. As such, we questioned:

RQ2: Do gratifications sought of adolescents' SEIM uses during the strict lockdown period differ according to the adolescents' gender, pubertal timing and sensation seeking levels?

Method

Sample and Procedure

Data were used from a three-wave longitudinal study conducted in Flanders, Belgium, over a period of 10 months. The study is part of the “Positive Body & Sex Project.”¹ In January 2020, the first wave of the data (W1) were collected among a representative sample of adolescents (aged between 12 and 18) from 16 schools in different parts of Flanders (i.e., the Flemish part of Belgium). During this period, no lockdown measures were established. In the presence of a researcher, a total of 1133 respondents filled in all variables of interest of the paper-and-pencil survey during class hours

¹ All measures of this project are publicly available on OSF via https://osf.io/wjs4c/?view_only=cd7cc3dce0c8426496282b132f5ddb6d6.

($M_{age} = 15.39$, $SD = 1.42$). Of this sample, 51.6% were boys and 48.4% were girls.

In March 2020 in Belgium, a strict lockdown period was established to reduce the spreading of the COVID-19 virus. During this strict lockdown period, schools were closed from March 2020 until May 18, 2020. Furthermore, non-essential transportation and meeting with others outside one's household were prohibited. Then, in May, an "exit strategy" was established in which gradual facilitation of the measures was operative. Individuals were allowed to steadily extend their social bubbles from 2 people outside one's household to 15 people outside one's household over a period of two months. General rules regarding physical distancing were still operative (i.e., keeping a distance of 1.5 m). From June until September 2020, these less restricted measures were operative. In October 2020, the rise of COVID-19 contamination levels again required more strict measures.

In June 2020, the second wave of the data (W2) were collected. The same representative sample in Belgium as in W1 was contacted again by the school principals to fill in an online survey at home. Respondents were rewarded with coupons worth 5 euros after completion of the online survey. Respondents were able to contact the first author of the study at any time via e-mail or *WhatsApp* if they had any questions or concerns. In total, 551 respondents ($M_{age} = 15.28$, $SD = 1.68$) filled the variables of interest of the online survey of W2. Of this sample, 31.8% were girls and 68.2% were boys. A notable reduction of the sample size at W2 (drop-out rate of 52.4%) reflects the change in data collection methods as a response to physical distancing measures operative in June (i.e., from offline paper-and-pencil to an online survey).

In October 2020, the third wave of the data (W3) were collected. In this month, respondents were able to go to school but physical distancing measures were still operative (i.e., keeping a distance of 1.5 m). The same sample in Belgium as in W1 and W2 was contacted again. Respondents were contacted by the school principals to fill in an online survey at home. Respondents were rewarded with coupons worth 7 euros after completion of the online survey. Monetary incentives were increased to diminish the possibility of a larger drop-out rate. Again, respondents were able to contact the first author of the study at any time via e-mail or *WhatsApp* if they had any questions or concerns. In total, 405 ($M_{age} = 15.67$, $SD = 1.74$) (drop-out rate of 27.5% since W2) filled in the online survey of W2. Of this sample, 31.4% were boys and 68.6% were girls.

Written active and passive parental consent for participation in the three waves was already obtained in December 2019 from parents whose adolescents were, respectively, younger than 16 years old and older than 16 years old. Parents were asked to give additional passive consent for W2 and W3 given the change in the data collection method. The respondents were assured that the survey would be processed

confidentially and anonymously and active consent was obtained at the outset of the survey. The study was approved by the ethical committee of KU Leuven, Belgium.

Respondents' answers in the different waves were matched via a unique code created for each respondent based on their school, the last digit of their telephone number, birthday, gender, and the number of brothers and sisters. Respondents were deleted if they were younger than 11 or older than 18 at the first two waves and younger than 11 or older than 19 at the last wave. In total, 299 adolescents filled in the variables of interest of this study at all 3 waves, 273 at two waves ($N_{W1 \text{ and } W2} = 187$, $N_{W2 \text{ and } W3} = 36$, $N_{W1 \text{ and } W3} = 50$), and 545 at only one wave ($N_{W1} = 529$, $N_{W2} = 4$, $N_{W3} = 12$). Note that some respondents' answers were unable to be matched in the different waves ($N = 16$). Respondents who did not fill in the variables of interest at baseline but did at W2 and either did not fill in these variables because they either did not complete the survey at baseline or were unable to be matched. Following procedures of existing longitudinal studies, data were used of respondents who participated in at least two of the three study waves (Keresteš & Štulhofer, 2020; Wright & Štulhofer, 2019). Further, the current study excluded respondents who did not fill in W2 given that pubertal timing and the level of sensation seeking were measured in this wave. The total sample consisted of 522 respondents of which 357 were girls (68.4%) and 165 were boys (31.6%) ($M_{age} = 15.04$, $SD = 1.45$). The gender misbalance can be expected as existing studies have demonstrated that female adolescents are more likely to continue participation in longitudinal studies than their male peers (e.g., Post et al., 2012). Further, 87.2% ($N = 455$) were heterosexual, 7.9% ($N = 41$) were non-heterosexual, and 5% ($N = 26$) did not know yet which sexual orientation they had. The majority of the sample was Western European ($N = 472$, 90.4%), followed by a mixed background ($N = 27$, 5.2%), an African background ($N = 10$, 1.9%), an Eastern European background ($N = 5$, 1%), and an Asian background ($N = 2$, 0.4%).

A possible attrition bias was assessed using a multivariate logistic regression analysis with two groups of participants as dependent variables (1 = *included in this study*, 0 = *excluded in this study*). Three significant differences emerged between adolescents who were included in this study and who were excluded from this study. In particular, boys, $\exp(B) = 4.21$, $B = 1.44$, $p < 0.001$, older adolescents, $\exp(B) = 1.13$, $B = 0.13$, $p < 0.01$, and heterosexual adolescents, $\exp(B) = 3.08$, $B = 1.12$, $p < 0.001$, were more likely to be excluded.

Measures

Socio-demographic variable. Adolescents' gender (0 = *boy*, 1 = *girl*), age, and sexual orientation (1 = *heterosexual*, 2 = *homosexual*, 3 = *bisexual*, 4 = *I do not know yet*) were

questioned at the three waves. The latter was recoded into a dummy variable with “0 = heterosexual” ($N = 466$) and “1 = non-heterosexual” ($N = 41$). Respondents who answered “I do not know yet” ($N = 15$) were coded as having a missing value. Respondents also indicated their ethnic background at W1 and W2 (1 = *Western European*, 2 = *Eastern European*, 3 = *African*, 4 = *North-American*, 5 = *Latin-American*, 6 = *Asian*, 7 = *Other*). Respondents were able to indicate more than one option (i.e., *Mixed*).

SEIM use. Adolescents’ SEIM use was assessed using Peter and Valkenburg’s (2008) 4-item scale. In the three waves, respondents indicated how many times, in the past five months, they looked at the following content online: (1) pictures with clearly exposed genitals, (2) videos with clearly exposed genitals, (3) pictures in which people were having sex, and (4) videos in which people were having sex. A seven-point Likert scale ranging from *never* (= 1) to *several times a day* (= 7) was used. The measure had a strong stability across the three waves, $r = 0.65\text{--}0.80$, $p < 0.01$, and was internally reliable, $\alpha_{W1} = 0.90$, $\alpha_{W2} = 0.92$, $\alpha_{W3} = 0.93$. Note that adolescents’ reflection on their use in the past five months covered at baseline a period in which no measures were active as the virus was believed to be not present in the country. In the second wave, the period covered the months in which the most strict measures were active, while in the third wave the months were covered in which a less restricted period of social distancing measures was operative given the lower contamination rates after the strict lockdown.

The Shapiro–Wilk test indicated non-normality of the SEIM data at the three waves, $p < 0.001$. Therefore, the variable was divided into four categories with the first category representing no SEIM use, the second category representing low SEIM use (i.e., less than once per month to one to three times per month), the third category representing middle SEIM use (i.e., once per week to several times per week), and the final category representing high SEIM use (i.e., each day to several times per day).

SEIM gratifications sought during the first lockdown period. The current study created a measure of SEIM motivations based on the following sources: (1) existing scales measuring motivations for the uses of sexual digital media (e.g., Paul & Shim, 2008) and (2) qualitative and quantitative data about reasons for SEIM use among adolescents (e.g., Grubbs et al., 2019). These gratifications sought were measured at W2. If adolescents indicated they used SEIM in W2 ($N = 274$), adolescents responded to 14 items clarifying why they used SEIM during the first lockdown period (i.e., from March to May) using a 7-point Likert scale (1 = *strongly disagree*; 7 = *strongly agree*).

Two items captured *sexual arousal motivations* (Ševčíková & Daneback, 2014): “Because I was aroused” and “To satisfy myself sexually.” Further, two items represented *sexual curiosity motivations* (Chen et al., 2013): “Because I was

curious” and “Because I wanted to know what it looks like.” Two items measured *sexual education motivations*: “To learn about sex” and “To learn new techniques regarding sex” (e.g., Bøthe et al., 2021). Two items reflected *sexual exploration motivations*: “To explore my sexual feelings” and “To explore what I find arousing” (e.g., Scarcelli, 2015). Also, six items reflected *emotional regulation motivations* based on Papacharissi and Rubin’s Internet Use Motives (2000) and the Motivations for Internet Pornography Use scale (Paul & Shim, 2008). Specifically, two items represented *boredom regulation*: “To pass the time when I’m bored” and “To fill the time.” Two items also represented *loneliness regulation*: “To feel less alone” and “To have the feeling that I’m not on my own.” Two items lastly reflected *stress regulation*: “To relax” and “To unwind.”

A confirmatory factor analysis was conducted using Mplus to validate the proposed factor structure. Generally, CFI and TLI values between 0.90 and 0.95 and RMSEA values between 0.05 and 0.08 indicate an acceptable model fit, and CFI and TLI values larger than 0.95 and RMSEA values smaller than 0.05 indicate good model fit (Kline, 2015). The CFA indicated an acceptable to good model fit, $\chi^2(56) = 152.66$, $p < 0.001$, CFI = 0.96, TLI = 0.94, RMSEA = 0.09. The subscales were proven to be internally consistent as significant correlations were found between the two items for sexual arousal motivations, $r = 0.77$, $p < 0.001$, sexual curiosity motivations, $r = 0.70$, $p < 0.001$, sexual education motivations, $r = 0.73$, $p < 0.001$, sexual exploration motivations, $r = 0.73$, $p < 0.001$, boredom regulation, $r = 0.92$, $p < 0.001$, loneliness regulation, $r = 0.93$, $p < 0.001$, and stress regulation, $r = 0.80$, $p < 0.001$. New variables were created by averaging the item scores.

Pubertal Timing. Pubertal statuses was measured in accordance with previous research (McCabe et al., 2002) by using four items from the Pubertal Development Scale (Petersen et al., 1988) at W2. Girls described the status of their breast growth, and boys reported their vocal changes. Answer options were (1) *not yet started*, (2) *has barely started*, (3) *is still going on*, (4) *seems complete*, or (5) *I do not know*. Given the sensitivity of such questions for adolescents, respondents could also not answer this question. Respondents who selected “I do not know yet” or decided to not answer the question were coded as having a missing value ($N = 127$). Reliability of the scale was confirmed with Cronbach’s alpha of 0.73 for boys and 0.60 for girls.

Following Beyens et al. (2015), the average scores of respondents of the same age and gender were subtracted from the score of each respondent. The new variable, pubertal timing, represented the respondent’s developmental status relative to that of the same-aged/same-gender respondents in the sample. A positive score indicates a more advanced pubertal maturation, while a negative score indicates a less advanced pubertal maturation. Respondents were categorized into

“late” ($N = 115$), “on-time” ($N = 171$), and “early” ($N = 109$) according to their pubertal timing scores with cutoffs at the 25th and 75th percentiles (Skoog et al., 2009).

Gender identity. Gender identification was measured at W1 using the short version of Bem Sex-Role Inventory (1981), validated among adolescents in the study of Fontayne et al. (2000). Using a 7-point Likert scale (1 = *strongly disagree*; 7 = *strongly agree*), respondents evaluated 20 items which reflected feminine and masculine traits such as “I am dominant” (i.e., masculine) and “I am a warm person” (i.e., feminine). The PCA resulted in a two-factor scale with 10 items representing masculine traits (e.g., “I am a born leader”) and eight feminine traits (e.g., “I am a sensitive person), $\alpha_{\text{girls}} = 0.81$, $\alpha_{\text{boys}} = 0.81$. Two items were deleted because they did not load on any of the factors (“I am always ready to help” and “I do not easily follow someone else’s orders”). The higher the scores, the more girls identified themselves as “feminine,” and the more boys identified themselves as “masculine” ($M = 5.34$, $SD = 0.79$). For RQ4, respondents were categorized into “low gender identification” ($N = 131$), “moderate gender identification” ($N = 238$), and “high gender identification” ($N = 130$) according to their gender identity scores with cutoffs at the 25th and 75th percentiles.

Sensation seeking. Sensation seeking was measured at W2 using the Brief Sensation Seeking Scale-4 (BSSS-4) (Stephenson et al., 2003). Using a 7-point Likert scale (1 = *strongly disagree*; 7 = *strongly agree*), respondents evaluated four items such as “I like new and exciting experiences, even if I have to break the rules,” $\alpha = 0.76$. Mean scores were used, with higher scores representing higher sensation seeking ($M = 4.59$, $SD = 0.94$). For RQ4, respondents were categorized into “low sensation seeking” ($N = 163$), “moderate sensation seeking” ($N = 217$), and “high sensation seeking” ($N = 142$) according to their sensation seeking scores with cutoffs at the 25th and 75th percentiles.

Statistical Analyses

To analyze H1 and H2, latent growth curve modeling (LGM) was used in Mplus (version 8.3, Muthén & Muthén, 2018). This approach enables simultaneous estimation of intraindividual (i.e., within-person) and interindividual (i.e., between-person) variability in change (Preacher et al., 2008). Both latent intercepts and slopes are observed to assess change over time. Particularly, latent intercepts represent the level of the outcome measure at which the time variable equals zero, whereas the latent slopes represent the linear rate at which the outcome measure changes (Duncan & Duncan, 2009). LGM holds a significant advantage over mixed effects hierarchical regression approaches as it has the potential for simultaneous modeling of growth in different constructs (Preacher et al., 2008).

Given that 57.2% of the total sample filled in the variables of interest at the three waves and 42.8% filled in the variables of interest at two waves, missing data occurred in the dataset. Multiple imputation was used to replace missing values in the analytical sample. Age, gender, sexual orientation, gender identity, and sensation seeking were included as auxiliary variables to obtain more precise estimates of the imputed variables. Graham et al. (2007) demonstrated that relatively few imputations (e.g., five) can lead to serious power falloff. Therefore, we generated and analyzed 100 imputations for the SEIM use variables. To explore H1, a linear LGM² (specified in months) was fit to SEIM use (Wang & Wang, 2019). First, an unconditional model (i.e., the model without the predictors) was tested. Model fit was evaluated using three goodness-of-fit-indices: the root mean square error of approximation (RMSEA), the Bentler Comparative Fit Index (CFI) and the Tucker–Lewis Index (TLI) (Hu & Bentler, 1999). Generally, CFI and TLI values between 0.90 and 0.95 and RMSEA values between 0.05 and 0.08 indicate an acceptable model fit, and CFI and TLI values larger than 0.95 and RMSEA values smaller than 0.05 indicate good model fit (Kline, 2015). In Mplus, the intercept mean (i.e., the mean for the expected level of SEIM use at W1) is fixed at zero as this is the default in growth models with latent growth indicators (Muthén & Muthén, 2018). The means of the slope represent the average rate of change in SEIM use across the three waves. Second, to address H2, we tested in a conditional model whether gender (categorical), gender identity (continuous), sexual orientation (categorical), pubertal timing (categorical), and sensation seeking (continuous) were related to the intercepts and slopes by adding these variables as predictors. We employed a robust weighted least squares (WLSMV) estimation. This approach is most suitable for ordered-categorical items in comparison with maximum likelihood estimation methods, especially when response categories follow asymmetric thresholds such as in the present study (Böthe et al., 2020).

Finally, to address the different gratifications sought of SEIM uses during physical distancing (RQ1), we measured gratifications sought at W2 and therefore only used the sample of adolescents who indicated at W2 that they had used SEIM. The Statistical Package for the Social Sciences (SPSS) version 26.0 (2019) was used to calculate descriptive information of the different SEIM motivations. To address individual differences regarding the occurrence of these gratifications sought (RQ2), MANOVA tests were conducted to explore gender, gender identity, sexual orientation, pubertal

² Note that a nonlinear quadratic growth model was also tested by adding a quadratic slope growth factor. However, Mplus was unable to calculate standard errors for the parameter estimates in this model, indicating that a quadratic growth model was too complex for the data.

Table 1 Descriptive statistics and zero-order correlations

	Min	Max	M(SD)	1.	2.	3.	4.	5.	6.	7.	8.
1. SEIM use (W1)	1	6	1.99 (1.31)	1	.641***	.603***	-.487***	.093*	-.226***	.036	.209***
2. SEIM use (W2)	1	7	2.00 (1.37)		1	.729***	-.424***	.149**	-.228***	.091	.209***
3. SEIM use (W3)	1	7	2.00 (1.36)			1	-.378***	.151**	-.223***	.142*	.220***
4. Gender	0	1	/				1	-.029	.440***	-.007	-.125**
5. Sexual orientation	0	1	/					1	-.107*	.049	-.006
6. Gender identity	2	7	5.34 (.79)						1	-.020	.011
7. Pubertal timing	-1.62	1.04	-.003 (.41)							1	-.077
8. Sensation seeking	1.25	7	4.59 (.94)								1

$N=522$. * $p < .05$; ** $p < .01$; *** $p < .001$

timing and sensation seeking differences. Given that the Shapiro–Wilk tests demonstrated the non-normality of all gratifications sought, $p < 0.001$, bootstrapping was used (Pek et al., 2018).

Results

Descriptive Statistics

Means, standard deviations, and zero-order correlations for all study variables are presented in Table 1. SEIM use at W1 correlated significantly with SEIM use W2 and W3. Further, SEIM use correlated significantly with gender, gender identity, sexual orientation, and sensation seeking across the three waves. This result means that boys, adolescents with low gender identification, non-heterosexual adolescents, and high sensation seeking adolescents, had higher SEIM use frequencies in each wave. Pubertal timing only correlated significantly with SEIM use at W3. Particularly, adolescents with a higher pubertal timing had higher SEIM frequencies at W3.

Table 2 shows that in general, no use of SEIM was the most frequently observed over the three waves (W1 = 42.3%; W2 = 47.5%; W3 = 30.3%), followed by a low use of SEIM (W1 = 33%; W2 = 33.5%; W3 = 32.8%). At W1, W2, and W3, respectively, 15.3%, 15.5%, and 8.2% indicated a middle SEIM use. Less than 4% of the total sample indicated high uses (i.e., daily uses) of SEIM across the three waves (W1 = 2.1%; W2 = 3.4%; W3 = 1.9%).

Sexually Explicit Internet Material Use Latent Growth Curve Model

H1 argued that there was an increase in Belgian adolescents' frequencies of SEIM use over the course of 2019–2020 in the context of the COVID-19 pandemic. To test this hypothesis, an unconditional linear model was tested. This model showed

a good model fit, $\chi^2(3) = 4.26$, $p < 0.001$, RMSEA = 0.024, CFI = 0.999, TLI = 1. The intercept mean (i.e., the mean for the expected level of SEIM use at W1) was fixed at zero as it is the default in growth models with latent growth indicators (Muthén & Muthén, 2018). The estimated mean value of the slope, $B = -0.007$, $SE = 0.031$, $p = 0.814$, does not indicate a significant increase or decrease in SEIM scores from W1 to W3 over a 15-month period. As such, the first hypothesis was not confirmed. Results further showed a significant variance of both the intercept, $var. = 0.889$, $SE = 0.085$, $p < 0.001$, and slope, $var. = 0.148$, $SE = 0.052$, $p < 0.01$, which means that intercept and slope factor of SEIM significantly vary across individuals.

Then, a conditional linear model was tested by adding predictors gender, hyper gender identity, pubertal timing, and sensation seeking (see Fig. 1). Predictors were allowed to covary. The conditional model had a good model fit, $\chi^2(8) = 10.03$, $p < 0.001$, RMSEA = 0.019, CFI = 0.999, TLI = 0.997. Gender, $B = -0.940$, $SE = 0.085$, $p < 0.001$, and sensation seeking, $B = 0.194$, $SE = 0.040$, $p < 0.001$, significantly predicted the intercept of SEIM use (i.e., the initial SEIM use scores at baseline). These results show that boys and adolescents with higher sensation seeking levels had higher initial SEIM scores at baseline. Sexual orientation, $B = -0.067$, $SE = 0.060$, $p = 0.267$, gender identity, $B = 0.073$, $SE = 0.060$, $p = 0.226$, and pubertal timing, $B = 0.333$, $SE = 0.177$, $p = 0.060$, did not have a significant link with the intercept of SEIM use. Regarding the slope of SEIM use, gender significantly predicted the slope of SEIM use, $B = 0.127$, $SE = 0.063$, $p < 0.05$. This means that girls had a higher increase in their SEIM scores. Sexual orientation, $B = -0.007$, $SE = 0.035$, $p = 0.831$, gender identity, $B = 0.034$, $SE = 0.039$, $p = 0.381$, pubertal timing, $B = 0.065$, $SE = 0.089$, $p = 0.465$, and sensation seeking, $B = -0.001$, $SE = 0.024$, $p = 0.977$, did not significantly predict the slope of SEIM use. As such, H2 partially confirmed given that gender predicted the trend of Belgian adolescents' frequencies of SEIM use over the course of 2019–2020 in the context of the COVID-19 pandemic.

Table 2 Frequencies of different SEIM uses according to gender, pubertal timing, and sensation seeking

	Gender		Gender identity			Pubertal timing			Sensation seeking			Sexual orientation		
	Boys (N=164)	Girls (N=358)	Low (N=131)	Moderate (N=238)	High (N=130)	Late (N=115)	On time (N=171)	Early (N=109)	Low (N=163)	Moderate (N=217)	High (N=142)	Het- erosexual (N=455)	Non- heterosexual (N=41)	
SEIM W1	Never (42.3%)	17.0%	54.1%	31.3%	45.4%	47.7%	46.1%	39.2%	38.5%	54.0%	38.7%	34.5%	43.5%	24.4%
	Low (33%)	32.1%	33.3%	32.1%	34.9%	32.3%	29.6%	35.1%	39.4%	30.1%	34.6%	33.8%	33.2%	39.0%
	Middle (15.3%)	37.0%	5.3%	26.0%	13.0%	11.5%	16.5%	15.8%	15.6%	8.0%	16.6%	21.8%	15.2%	22.0%
	High (2.1%)	5.5%	0.6%	3.8%	1.3%	1.5%	2.6%	1.8%	2.8%	0.6%	1.8%	4.2%	2.2%	2.4%
SEIM W2	Never (47.5%)	26.7%	57.1%	35.1%	50.0%	52.3%	53.9%	40.9%	38.5%	61.3%	46.1%	33.8%	49.5%	22.0%
	Low (33.5%)	29.7%	35.3%	34.4%	34.9%	33.1%	27.8%	36.3%	40.4%	27.0%	34.6%	39.4%	32.5%	46.3%
	Middle (15.5%)	33.3%	7.3%	22.9%	13.0%	12.3%	16.5%	18.1%	17.4%	9.8%	17.1%	19.7%	14.9%	24.4%
	High (3.4%)	10.3%	0.3%	7.6%	2.1%	2.3%	1.7%	4.7%	3.7%	1.8%	2.3%	7.0%	3.1%	7.3%
SEIM W3	Never (30.3%)	17.0%	36.4%	22.1%	31.9%	32.3%	30.4%	28.1%	23.9%	44.2%	26.3%	20.4%	29.9%	24.4%
	Low (23.8%)	16.4%	27.2%	19.1%	23.5%	30.8%	16.5%	29.8%	29.4%	22.7%	27.6%	19.0%	24.2%	29.3%
	Middle (8.2%)	17.6%	3.9%	12.2%	7.6%	5.4%	6.1%	9.9%	9.2%	5.5%	8.8%	10.6%	7.7%	12.2%
	High (1.9%)	5.5%	0.3%	3.8%	1.7%	0.8%	0%	2.3%	2.8%	1.2%	0.9%	4.2%	1.3%	9.8%

N=522. Low SEIM use = “Less than once per month” and “One to three times per month.” Middle SEIM use = “Once per week” and “Several times per week.” High SEIM use = “Each day” and “Several times per day.” Regarding pubertal timing 127 missing values (24.3%) were observed; for sexual orientation, 26 missing values were observed (5%)

Fig. 1 Conditional latent growth model for SEIM use. Note. $\chi^2(8)=10.303$, $p<.001$, RMSEA=.019, CFI=.999, TLI=.997. Values reflect coefficients. For clarity of presentation, error terms and non-significant predictors are not shown. * $p<.05$. ** $p<.01$. *** $p<.001$

Conditional latent growth model for SEIM use.

Table 3 Gratifications sought of SEIM use according to adolescents' SEIM use frequencies

Gratifications sought	SEIM use frequencies		
	Low M (SD)	Middle M (SD)	High M (SD)
Arousal ($M=5.16$, $SD=1.66$)	4.66 (1.81)	5.82 (1.05)	6.17 (1.15)
Curiosity ($M=3.29$, $SD=1.75$)	3.36 (1.45)	3.15 (1.72)	3.44 (1.20)
Education ($M=3.09$, $SD=1.75$)	3.11 (1.67)	3.14 (1.84)	2.70 (2.02)
Exploration ($M=3.71$, $SD=1.87$)	3.57 (1.77)	3.81 (1.84)	4.39 (2.25)
Boredom ($M=3.94$, $SD=1.95$)	3.45 (1.79)	4.54 (1.92)	5.11 (2.09)
Loneliness ($M=2.55$, $SD=1.66$)	2.26 (1.44)	2.68 (1.65)	4.19 (2.22)
Stress ($M=4.29$, $SD=1.74$)	3.76 (1.70)	5.01 (1.42)	5.19 (1.95)

Means and standard deviations are calculated using the sample of respondents in the different groups of W2 who used SEIM ($N=274$)

Gratifications Sought of Sexually Explicit Internet Material Use During the Strict Lockdown Period

RQ1 asked about the different gratifications sought of adolescents' SEIM use during the first lockdown period. Of the total sample, 52.5% ($N=274$) indicated that they used SEIM at least once during the strict lockdown period. Among these 274 adolescents, arousal needs were the most prominent ($M=5.16$, $SD=1.66$), followed by stress regulation ($M=4.29$, $SD=1.74$), boredom regulation ($M=3.94$, $SD=1.95$), sexual exploration ($M=3.71$, $SD=1.87$), sexual curiosity ($M=3.29$, $SD=1.75$), and sexual education ($M=3.09$, $SD=1.75$). Loneliness regulation was the least prominent gratification sought for SEIM use during the first lockdown period ($M=2.55$, $SD=1.66$) (see Table 3).

Table 3 shows that arousal needs were the most prominent among all adolescents, regardless of their SEIM use

frequencies during the strict lockdown period (i.e., low, middle, and high SEIM use frequencies). Particularly, among low ($M=4.66$, $SD=1.81$), middle ($M=5.82$, $SD=1.05$), and high SEIM use adolescents ($M=6.17$, $SD=1.15$), arousal needs were the most prominent. The MANOVA analysis with bootstrapping shows that significant differences emerged regarding this arousal gratification sought, $F(2, 232)=18.10$, $p<0.001$. Turkey post hoc tests revealed that among high use adolescents ($M=6.17$, $SD=1.15$), arousal needs were more prominent than among low use adolescents ($M=4.66$, $SD=1.81$), $p<0.001$. Also, among low use adolescents, arousal needs were less prominent than among middle use adolescents ($M=5.82$, $SD=1.05$), $p<0.001$. Middle and high use adolescents did not differ in terms of this gratification sought, $p=0.662$. Significant differences further emerged with regard to boredom regulation, $F(2, 232)=12.53$, $p<0.001$, loneliness

regulation, $F(2, 232) = 12.34$, $p < 0.001$, and stress regulation, $F(2, 232) = 17.54$, $p < 0.001$. Specifically, among high use adolescents ($M = 5.11$, $SD = 2.09$), boredom regulation needs were more prominent than among low use adolescents ($M = 3.45$, $SD = 1.79$), $p < 0.01$. Also, among low use adolescents, boredom regulation needs were less prominent than among middle use adolescents ($M = 4.54$, $SD = 1.92$), $p < 0.001$. Again, middle and high use adolescents did not differ in terms of this gratification sought, $p = 0.466$. In terms of loneliness regulation, this gratification sought was more prominent among high use adolescents ($M = 4.19$, $SD = 2.22$) compared to middle ($M = 2.68$, $SD = 1.65$), $p < 0.01$, and low use adolescents use adolescents ($M = 2.26$, $SD = 1.44$), $p < 0.001$. Low and middle use adolescents did not differ in terms of this gratification sought, $p = 0.146$. Regarding stress regulation, this motivation was more frequently observed in high use adolescents ($M = 5.19$, $SD = 1.95$) than among low use adolescents ($M = 3.76$, $SD = 1.70$), $p < 0.01$. Among middle use adolescents ($M = 5.01$, $SD = 1.42$), this motivation was more prominent than among low use adolescents, $p < 0.001$. Middle and high use adolescents did not differ in terms of this gratification sought, $p = 0.898$.

Further, individual differences (i.e., gender, gender identity, sexual orientation, pubertal timing, and sensation seeking levels) regarding these different gratifications sought were examined (RQ2) (see Table 4). Boys and girls differed significantly in terms of the uses of SEIM during the strict lockdown period out of sexual curiosity, $F(1, 233) = 4.24$, $p < 0.05$, and to combat boredom, $F(1, 233) = 9.98$, $p < 0.01$. Specifically, girls indicated more frequently to use SEIM during the strict lockdown period to satisfy their sexual curiosity ($M = 3.52$, $SD = 1.76$) in comparison with boys ($M = 3.05$, $SD = 1.72$). As for boredom regulation, this gratification sought was more prevalent among boys ($M = 4.35$, $SD = 1.91$) than among girls ($M = 3.56$, $SD = 1.92$).

Regarding adolescents' gender identity (i.e., low, moderate, and high) and sexual orientation (i.e., heterosexual and non-heterosexual), no significant differences were found between these groups for gratifications sought of SEIM use during a strict lockdown period.

Results further showed that adolescents' occurrence of gratifications sought differed significantly based among the three pubertal timing groups (i.e., late, on-time, and early). Particularly, the three pubertal timing groups significantly differed in terms of sexual curiosity, $F(2, 187) = 5.40$, $p < 0.01$, and sexual exploration gratification sought, $F(2, 187) = 3.16$, $p < 0.05$. Specifically, sexual curiosity motivations were significantly more prominent in adolescents with late pubertal timing ($M = 4.20$, $SD = 1.51$) in comparison with on-time pubertal timing adolescents ($M = 3.06$, $SD = 1.72$), $p < 0.01$. Early pubertal timing adolescents ($M = 3.36$, $SD = 1.89$) did not significantly differ in terms of this motivation with late, $p = 0.083$, and on-time adolescents, $p = 0.562$. In terms

Table 4 Gratifications sought of SEIM use during the first lockdown period

Gratifications	Gender		Gender identity			Sexual orientation		Pubertal timing			Sensation seeking		
	Boy M (SD)	Girl M (SD)	Low M (SD)	Moderate M (SD)	High M (SD)	Heterosexual M (SD)	Non-heterosexual M (SD)	Late M (SD)	On-time M (SD)	Early M (SD)	Low M (SD)	Moderate M (SD)	High M (SD)
Arousal	5.36 (1.40)	4.98 (1.86)	5.24 (1.65)	5.02 (1.66)	5.32 (1.78)	5.09 (1.70)	5.71 (1.15)	4.78 (1.87)	5.34 (1.56)	5.08 (1.86)	4.79 (1.84)	5.10 (1.65)	5.46 (1.52)
Curiosity	3.05 (1.72)	3.52 (1.76)	3.14 (1.78)	3.35 (1.76)	3.46 (1.75)	3.25 (1.76)	3.65 (1.80)	4.20 (1.51)	3.06 (1.72)	3.36 (1.89)	3.39 (1.66)	3.29 (1.68)	3.24 (1.91)
Education	2.91 (1.71)	3.26 (1.78)	2.86 (1.84)	3.12 (1.64)	3.36 (1.83)	3.06 (1.70)	3.27 (1.70)	3.78 (1.65)	3.03 (1.72)	3.11 (1.89)	2.94 (1.76)	3.03 (1.59)	3.26 (1.94)
Exploration	3.57 (1.91)	3.85 (1.83)	3.47 (1.92)	3.89 (1.83)	3.75 (1.93)	3.66 (1.83)	3.90 (2.14)	4.56 (1.51)	3.70 (1.80)	3.64 (1.99)	3.61 (1.99)	3.71 (1.61)	3.76 (2.11)
Boredom	4.35 (1.91)	3.56 (1.92)	3.90 (2.12)	4.12 (1.85)	3.53 (1.84)	3.88 (1.91)	4.40 (2.20)	4.09 (1.52)	4.00 (1.95)	3.87 (2.04)	3.20 (1.95)	3.88 (1.81)	4.45 (1.99)
Loneliness	2.73 (1.76)	2.37 (1.54)	2.57 (1.83)	2.54 (1.63)	2.55 (1.51)	2.57 (1.62)	2.54 (1.20)	3.08 (1.66)	2.41 (1.55)	2.30 (1.67)	2.32 (1.54)	2.59 (1.56)	2.62 (1.84)
Stress	4.49 (1.69)	4.12 (1.77)	4.28 (1.88)	4.25 (1.68)	4.47 (1.73)	4.22 (1.74)	4.81 (1.73)	4.22 (1.74)	4.45 (1.71)	4.05 (1.90)	3.84 (1.77)	4.42 (1.66)	4.38 (1.81)

Means and standard deviations are calculated using the sample of respondents in the different groups of W2 who used SEIM ($N = 274$)

of sexual exploration, this motivation was more prominent among late adolescents ($M = 4.56$, $SD = 1.51$) than among on-time adolescents ($M = 3.70$, $SD = 1.80$), $p = 0.050$. Early pubertal timing adolescents ($M = 3.64$, $SD = 2.00$) did not significantly differ in terms of this motivation with on-time pubertal timing adolescents ($M = 3.70$, $SD = 1.80$), $p = 0.977$, and with late adolescents, $p = 0.065$.

As for sensation seeking differences, adolescents with low, moderate, and high sensation seeking levels differed significantly in terms of boredom regulation gratifications sought, $F(1, 232) = 6.47$, $p < 0.01$. Particularly, among adolescents with high sensation seeking levels, this motivation was more prominent ($M = 4.45$, $SD = 2.00$) in comparison with low sensation seeking levels ($M = 3.21$, $SD = 1.95$), $p < 0.01$. Low sensation seeking adolescents did not significantly differ in terms of this motivation with middle sensation seeking adolescents ($M = 3.88$, $SD = 1.81$), $p = 0.108$, and middle sensation seeking adolescents did not differ with high sensation seeking adolescents, $p = 0.112$.

Discussion

This study addressed Belgian adolescents' changes in SEIM use throughout 2019–2020 in the context of the COVID-19 pandemic. Our results offer a response to recent worries of sexual health scholars (e.g., Mestre-Bach et al., 2020) in terms of the exceptional context of the pandemic possibly creating an increase in some adolescents' SEIM uses. Overall, results revealed that adolescents' SEIM uses did not increase throughout 2019–2020. These results thus temper the concerns that have arisen regarding SEIM use (e.g., Peris-sini et al., 2020). In times of social isolation, adolescents in general do not seem to turn more frequently to SEIM use to cope with challenges raised in the context of the pandemic. Potentially, other contextual changes may be more profound in predicting such changes in adolescents' SEIM uses. For instance, a relationship break-up may be a more powerful trigger to use SEIM to compensate for the lack of sexual interactions with a former partner. The study of Hesse and Floyd (2019) showed some evidence that SEIM use can be used to deal with the perception of affection deprivation in close relationships. However, when it comes to adolescents' SEIM uses, no research has explored how profound contextual changes other than the COVID-19 pandemic can potentially stimulate SEIM use.

We further recommend scholars and practitioners to pay attention to how male and female adolescents experienced times of social isolation. Our results did not demonstrate a significant change in SEIM use during the pandemic according to adolescents' gender identity, sexual orientation, sensation seeking, and pubertal status, yet did show such a change for gender. At baseline, boys consumed more SEIM use,

but when viewing the change in SEIM use, girls showed a greater, increasing change than boys. This finding contradicts existing literature on gender differences in SEIM uses as, in a normal context, boys typically show a greater increase in SEIM use (Rasmussen & Bierman, 2016). This unexpected result can be explained by the facilitating context created by the COVID-19 pandemic to use SEIM. Particularly, with schools closing and social distancing measures being implemented during the COVID-19 pandemic, adolescents' in-person contact with peers declined. The qualitative study of Scarcelli (2015) shows that peer groups play an important role in girls' choices to consume SEIM. In peer groups, boys' uses of SEIM are more expected than those of girls. Female peers generally discourage SEIM use. Yet, when a girl does indicate to use SEIM, the peer group provides norms about the type of content one should watch and should not watch, such as viewing sadomasochistic pornographic content. With the COVID-19 pandemic limiting girls' in-person contact with peer groups, it may be possible that peer group expectations were less explicitly present. As such, girls may have explored SEIM more freely and in a more individual manner, resulting in a greater change in girls' SEIM uses during the pandemic.

The gratifications of SEIM use during a strict lockdown period hint at changes in why adolescents consumed SEIM. Adolescents mainly turned to SEIM during the strict lockdown period as a response to sexual arousal needs and the prevalence of these needs did not significantly differ according to adolescents' gender, gender identity, sexual orientation, pubertal timing, and sensation seeking. Such arousal motivations can be considered as rather harmless (e.g., Paul & Shim, 2008) and expected, especially among adolescents given their developmental context (Fortenberry, 2013a). Prior studies exploring SEIM use motivations in normal contexts indicate that this particular motivation is the most prevalent among adolescents and adults (Grubbs et al., 2019). Future research can benefit from observing this particular motivation in explaining possible effects. Particularly, given the limitation of offline sexual stimuli during a strict lockdown period, it may be possible that adolescents became more dependent on SEIM to sexually gratify themselves. When exploring such consequences of the strict lockdown period, future research is especially warranted to pay attention to high SEIM use adolescents as this motivation was the most prominent among this group.

Interestingly, findings indicated that the need to reduce stress and boredom were important motivations of SEIM uses during a strict lockdown period. Loneliness regulation was the least prevalent. When addressing the prevalence of these motivations in the normal context in which no lockdown measures were active, a contrast can be noticed as these motivations are usually the least prominent in normal contexts (e.g., Bóthe et al., 2021). Recent reports exploring

adolescents' well-being in the context of the COVID-19 pandemic can explain this disparity as they point to the significant rising of adolescents' stress levels and feelings of boredom during times of social distancing (e.g., Francisco et al., 2020).

With boredom regulation, adolescents' SEIM use may be interpreted as pleasure-seeking behavior, whereas stress regulation can point to avoidance-oriented, coping-related behavior (Böthe et al., 2021). These two behaviors may facilitate the development of problematic SEIM use, especially when findings indicate that such motivations were significantly more present among adolescents who use SEIM each day or, even, several times per day (Böthe et al., 2020; Mestre-Bach et al., 2020; Sinha, 2008). However, the current study could not distinguish between problematic high frequency uses and non-problematic high frequency uses as factors signaling problematic SEIM use (e.g., withdrawal) were not measured (Böthe et al., 2020). Therefore, no conclusions can be made regarding the possible development of problematic SEIM use in adolescents. Future studies are recommended to account for factors characterizing problematic SEIM use when observing this online sexual behavior in adolescents in future (strict) lockdown periods. When observing the possible implications of SEIM use motivated by boredom and stress regulation, future research is advised to account for adolescents' gender. Compared to girls, boys more frequently indicated to use SEIM during a strict lockdown period to combat boredom. These findings are in line with previous research on these gratifications in the normal context in which no lockdown measures were active (Grubbs et al., 2019). Also, research should account for adolescents' sensation seeking levels as high sensation seeking adolescents were more frequently motivated to use SEIM to combat boredom and stress, in comparison with low sensation seeking adolescents. This matches with sensation seekers focus on stimulating activities (e.g., Ševčíková et al., 2013) to regulate feelings of boredom and cope with stress.

During times of social isolation, adolescents also turned to SEIM to explore their sexual selves, gratify their sexual curiosity, and learn about sexual behaviors. Similar results on these gratifications occurred in the normal context in which no lockdown measures were active (Grubbs et al., 2019). Given the biased sexual content often embedded in SEIM (e.g., no use of contraceptives), the use of this content as an explorative and educational tool during a strict lockdown period can pose harmful implications for adolescents' sexual knowledge, attitudes, and behaviors (Peter & Valkenburg, 2016). Future studies exploring such possible effects should account for this study's findings indicating that these motivations were the least prevalent among adolescents. In line with existing studies (e.g., Wallmyr & Welin, 2006), sexual curiosity motivations were the most frequently observed in girls but also among late adolescents. Regarding the latter,

SEIM use to explore one's sexuality was also more prominent in late adolescents in comparison with on-time adolescents. No previous studies have found such differences in terms of pubertal timing. Sexual curiosity and exploratory motivators can be expected among late adolescents as they often lack the offline sexual experience to satisfy their curiosity and explore their sexuality (e.g., Michaud et al., 2006) and, therefore, may more easily turn to SEIM. In contrast to our assumptions and those of existing literature (Böthe et al., 2020, 2021), non-heterosexual adolescents and adolescents who identify less as "masculine" and "feminine" were not significantly more motivated to use SEIM to explore their sexuality in comparison with heterosexual adolescents and adolescents with moderate and high gender identity levels. It may be possible that the context of the COVID-19 pandemic made the uses of SEIM to explore one's sexuality equally relevant among all sexual orientations and gender identities. Differences may arise, however, when exploring what these different groups of adolescents learn from SEIM. For example, it may be possible that non-heterosexual adolescents mainly learn more about their sexual orientation when watching pornographic content, whereas heterosexual adolescents may mainly learn how to initiate sex.

Lastly, scholars are advised to take on a broader perspective on adolescents' media uses during the COVID-19 pandemic. Indeed, recent research shows that other online sexual behavior such as sexting (Maes & Vandenbosch, 2022) and more general media, such as social media use (Cauberghe et al., 2021), operated as a tool to cope with feelings of loneliness and stress and to temporarily replace meaningful offline social interactions. The implications of these media uses as a tool to cope with the COVID-19 pandemic should especially be accounted for by future research.

Limitations

Several limitations need to be considered when interpreting the findings of the current study. First, this study was restricted by its application of a three-wave design. Future research may consider a four- or a five-wave design to test the adolescents' changes in SEIM use frequencies during and, even, after the COVID-19 pandemic more extensively.

Further, a gender imbalance was observed within the current study's sample. Almost two-third of the respondents were girls. Such an imbalance can be expected as girls are more likely to continue participation in longitudinal studies than boys (e.g., Post et al., 2012). The imbalance poses limitations on the generalizability of the current study's results. Therefore, future longitudinal studies may anticipate the fallout of male respondents by collecting more responses of boys at baseline. Similarly, the majority of the total sample identified as heterosexual (89.3%). To obtain conclusive and generalizable results when comparing heterosexual with

non-heterosexual groups of adolescents, future studies are encouraged to specifically target non-heterosexual adolescents when collecting data.

Also, the study was conducted in Flanders, Belgium, limiting the generalizability of the current study's findings to other cultural contexts. This country is known for its rather liberal policy toward pornography and adolescent sexuality (e.g., Štulhofer & Rimac, 2009). Therefore, different findings may emerge in countries with more conservative approaches to sexual matters. Cross-nationally comparative research is necessary to study the potential context sensitivity of the results.

The current study is also limited in its assessment of adolescents' gender identity. Particularly, we used a short version of Bem Sex-Role Inventory (Bem, 1981). Scholars have expressed doubts about the uses of this inventory to measure individuals' gender identities as it is conceptualized in a bipolar, dichotomous manner (Deogracias et al., 2007). Individuals who have an uncertain or confused gender identity, or are transitioning, do not fit in this dichotomous scheme. As such, those adolescents may have been wrongly assessed. Future studies are encouraged to employ different measures to measure gender identity in adolescents, such as the Gender Identity/Gender Dysphoria Questionnaire for adolescents (Deogracias et al., 2007).

Another limitation pertains to the attrition bias. Boys, older adolescents, and heterosexual adolescents had lower odds of being included in the analyses compared to their peers. Taking into account that boys and older adolescents are associated with higher levels of SEIM use (e.g., Peter & Valkenburg, 2016), the attrition bias has likely affected our assessment of SEIM use trajectories.

Lastly, the current study did not observe adolescents' motivations for SEIM use in W1. Therefore, no meaningful comparisons could be made between adolescents' motivations of SEIM use before the strict lockdown period and during the strict lockdown period.

Conclusion

This study is the first to explore adolescents' SEIM use trajectories over the course of 2019–2020 in the context of the COVID-19 pandemic. No overall increase of adolescents' SEIM was observed over a 15-month period. Gender and sensation seeking were related to initial levels of SEIM use frequencies, but only gender predicted a change in SEIM use frequencies. Surprisingly, girls showed a greater increase. The most prevalent motivations for SEIM use during a strict lockdown period were sexual arousal, boredom regulation, and stress regulation. Gender, pubertal timing, and sensation seeking differences were found regarding these gratifications sought and point at different reasons for why subgroups of adolescents consumed SEIM during the pandemic.

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Declarations

Conflict of interest The authors declared that they have no conflict of interest.

Ethical Approval The study was approved by the ethical committee of KU Leuven, Belgium.

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