JYU DISSERTATIONS 811

Henri Lahti

Growing Up Online

Adolescents' Digital Media Use and Its Relationships with Individual Factors, Social Factors, and Health

UNIVERSITY OF JYVÄSKYLÄ
FACULTY OF SPORT AND
HEALTH SCIENCES

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ABSTRACT

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The research reported in this thesis examined patterns of adolescent digital media use (digital media activity and problematic social media use) and exposure to social media threats, together with individual and social factors, health outcomes, and moderating processes. It derived inspiration from Valkenburg and Peter's (2013) Differential Susceptibility to Media Effects Model (DSMM). Within the research, a cross-national comparative approach and a time-point perspective were applied. The thesis is based on four original research articles (I–IV). These utilized data from the nationally representative Health Behaviour in School-aged Children (HBSC) survey. The data for this were obtained from Finland in 2018 and 2022, and from Germany, Estonia, Belgium, Poland, and the Czech Republic in 2018. Finnish Delphi study data were also applied. The research utilized a comprehensive set of validated measures on digital media use, individual and social factors, and health outcomes. Various statistical methods were applied, including latent class analysis, random-effects meta-analytic pooling, and regression analyses. Finnish adolescent digital media use was confirmed as complex and multidimensional. The results showed that adolescent digital media use can be explained via person-oriented internet user profiles, categorized as friendship-driven, interest-driven, irregular, abstinent, and excessive users. Problematic social media use was reported by every tenth of Finnish adolescent. Furthermore, Finnish adolescents were found to be exposed to a range of social media threats, including cyberbullying and sexual harassment. Various individual and social factors were found to explain the patterns of digital media use and exposure to social media threats. Furthermore, the patterns of use and social media threats explained adolescent health. Problematic social media use and daily and weekly encounters with social media threats were systematically associated with negative health outcomes, including poor self-rated health. The research identified resources that can potentially protect adolescents from problematic social media use and its ensuing negative health consequences. The thesis, which applies an equity lens, lays a foundation for developing strategies, interventions, policies, and education to promote safe and secure digital media for adolescents.

Keywords: Digital media, Internet, Social media, Problematic social media use, Social media threat, Adolescent, Health

TIIVISTELMÄ (ABSTRACT IN FINNISH)

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Nuorten digitaalisen median käyttö ja sen yhteydet yksilöllisiin taustatekijöihin, sosiaalisiin taustatekijöihin ja terveyteen
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Tässä väitöskirjassa tutkittiin nuorten digitaalisen median käyttötapoja (digitaaliset aktiviteetit, ongelmallinen sosiaalisen median käyttö) ja sosiaalisen median uhkatilanteita sekä niihin liittyviä yksilöllisiä taustatekijöitä, sosiaalisia taustatekijöitä, terveyden indikaattoreita ja moderoivia prosesseja. Väitöskirja sai inspiraationsa Valkenburgin & Peterin Differential Susceptibility to Media Effects Model (DSMM) -mallista. Väitöskirja koostuu neljästä alkuperäisestä tutkimusartikkelista (I-IV). Aineistona käytettiin kansallisesti kattavaa WHO-Koululaistutkimuksen aineistoa Suomesta vuosilta 2018 ja 2022 sekä Saksasta, Virosta, Belgiasta, Puolasta ja Tšekistä vuodelta 2018. Väitöskirjassa hyödynnettiin myös Delfoi-tutkimusaineistoa Suomesta. Väitöskirjassa käytettiin validoituja mittareita sekä erilaisia tilastollisia menetelmiä, kuten latentti luokka-analyysiä ja erilaisia regressioanalyysejä. Tulokset osoittivat, että suomalaisten nuorten digitaalisen median käyttöä voidaan selittää internetin käyttäjäprofiileilla: ystäväorientoituneet, kiinnostusorientoituneet, epäsäännölliset, ja pidättyväiset käyttäjät sekä suurkuluttajat. Lisäksi joka kymmenes suomalaisnuori kuului sosiaalisen median ongelmakäyttäjiin. Tulokset paljastivat, että suomalaiset nuoret kohtasivat erilaisia sosiaalisen median uhkatilanteita, kuten nettikiusaamista ja seksuaalista häirintää. Yksilölliset ja sosiaaliset taustatekijät selittivät digitaalisen median käyttötapoja sekä altistumista sosiaalisen median uhkatilanteille. Lisäksi digitaalisen median käyttötavat sekä sosiaalisen median uhkatilanteet selittivät nuorten terveyttä. Erityisesti ongelmallinen sosiaalisen median käyttö ja päivittäiset sekä viikoittaiset kohtaamiset sosiaalisen median uhkatilanteiden kanssa olivat kielteisesti yhteydessä terveyden osoittimiin, kuten huonoon itsearvioituun terveyteen. Väitöskirjassa tunnistettiin resursseja (esim. terveyden lukutaito, perheen tuki) jotka voivat suojata nuoria sosiaalisen median ongelmakäytöltä sekä siihen yhteydessä olevilta kielteisiltä terveyden osoittimilta. Tuloksia voidaan käyttää strategioiden, interventioiden, poliittisen päätännän ja opetuksen tukena, joiden tavoitteena on edistää turvallista digitaalisen median käyttöä nuoruudessa ja nuorten yhdenvertaisia mahdollisuuksia turvalliseen digitaalisen median käyttöön.

Avainsanat: Digitaalinen media, Internet, Sosiaalinen media, Sosiaalisen median ongelmakäyttö, Sosiaalisen median uhkatilanteet, Nuori, Terveys

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I dedicate this thesis to those close to me, and to everyone who has supported me along the way.

Jyväskylä 13.6.2024
Henri Lahti

ORIGINAL PUBLICATIONS AND AUTHOR CONTRIBUTION

This thesis is based on the following original publications, which will be referred to by their Roman numerals. The thesis also includes unpublished data.

I. Lahti, H., Lyyra, N., Hietajärvi, L., Villberg, J., & Paakkari, L. (2021). Profiles of internet use and health in adolescence: A person-oriented approach. *International Journal of Environmental Research and Public Health, 18*(13), 6972. https://doi.org/10.3390/ijerph18136972

II. Lahti, H., Kulmala, M., Hietajärvi, L., Lyyra, N., Kleszczewska, D., Boniel-Nissim, M., Furstova, J., van den Eijnden, R.J.J.M., Sudeck, G., & Paakkari, L. (2024). What counteracts problematic social media use in adolescence? A cross-national observational study. *Journal of Adolescent Health, 74*(1), 98-112. https://doi.org/10.1016/j.jadohealth.2023.07.026

III. Lahti, H., Kulmala, M., Lyyra, N., Mietola, V., & Paakkari, L. (2024). Problematic situations related to social media use and competencies to prevent them: Results of a delphi study. *Scientific Reports, 14*, 5275. https://doi.org/10.1038/s41598-024-55578-5

IV. Lahti, H., Kokkonen, M., Hietajärvi, L., Lyyra, N., & Paakkari, L. (2024). Social media threats and health among adolescents: Evidence from the health behaviour in school-aged children study. *Child and Adolescent Psychiatry and Mental Health* 18, 62. https://doi.org/10.1186/s13034-024-00754-8

As the first author of the original publications, I was primarily responsible for conceptualizing and writing the manuscripts while considering the comments from my supervisors and other co-authors. I was primarily responsible for drafting the study questions and designs for the manuscripts, and preparing the data for statistical analysis (except in Study II, in which Markus Kulmala had the primary responsibility for preparing the data for analysis). I conducted the statistical analyses collaboratively with Lauri Hietajärvi (Lauri had the primary responsibility for the Latent Class Analysis in Study I), Jari Villberg (Study I), and Markus Kulmala (Markus had the primary responsibility for the analyses in Studies II and III). In Study IV, I performed the analyses independently. I actively participated in the collection of the data used in Studies III and IV. In Studies I and II, I was fortunate in having access to pre-existing data.

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ABBREVIATIONS

AIC	Akaike Information Criterion
B	Beta coefficient
BIC	Bayesian Information Criterion
BLRT	Bootstrapped Likelihood Ratio Test
CI	Confidence Interval
DSM	The Diagnostic and Statistical Manual of Mental Disorders
DSMM	The Differential Susceptibility to Media Effects Model
FAS	Family Affluence Scale
HBSC	Health Behaviour in School-aged Children study
LCA	Latent Class Analysis
M	Mean
MCAR	Missing Completely At Random
n	Number
OR	Odds ratio
p	Significance Probability
PSMU	Problematic Social Media Use
RMSEA	Root Mean Square Error of Approximation
RQ	Research Question
SD	Standard Deviation
SE	Standard Error
SMD	Social Media Disorder scale
VLMR	Vuong-Lo-Mendell-Rubin
WHO	World Health Organization
$\chi 2$	The Model Chi-square

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ORIGINAL PAPERS

1 INTRODUCTION

Adolescents growing up in the world today belong to a unique generation. They are maturing in a society where use of the internet and social media has become intensive, pervasive, and increasingly integrated into their daily lives (Valkenburg & Piotrowski, 2017; Vogels et al., 2022). The internet is a global network of computers and servers, interconnected through communication protocols that enable the exchange of data and information across vast distances, and provide a foundation for a wide array of digital services, applications, and activities (Leiner et al., 2009). Within this digital ecosystem, the social media emerge as a subset, comprising online platforms and applications designed so that users can create, share, and engage with content such as texts, images, videos, and multimedia (Bayer et al., 2020; Boer, 2022). These platforms promote social interaction and communication among users, enabling them to form communities, networks, and connections based on shared interests, activities, backgrounds, or real-life relationships, and to establish and maintain personal profiles (Obar & Wildman, 2015). Most adolescents use the internet and social media via their smartphones, allowing them to access these services at any place or time (Boer, 2022).

Recent studies indicate that the proportion of adolescents aged 13–17 who are constantly online has almost doubled, from 24% in 2015 to 45% in 2018 (Anderson & Jiang, 2018; Lenhart et al., 2015). Simultaneously, 41% of 15-year-olds globally are almost constantly on social media throughout the day (Inchley et al., 2020), and a substantial number of adolescents (49% of boys and 58% of girls) admit that they would find it difficult to stop using social media (Vogels et al., 2022). According to Official Statistics of Finland (2021), 99% of Finnish adolescents have access to smartphones, while 98% use the internet several times a day and 94% use various social networking sites. These statistics illustrate the point that adolescents, in particular, have subscribed to the cultural norm of continuous online presence and social networking (Boer, 2022). Internet and social media (henceforth referred to as *digital media* in this thesis) enable adolescents to forge and sustain friendships on social networking sites, communicate with peers via instant messaging apps, and gain peer approval

through likes (Boer, 2022; Granic et al., 2020). They offer a space for adolescents to chronicle and share their personal experiences, gain insights from their peers' lives, and access information, entertainment, and inspiration (van der War et al., 2022).

Whilst the benefits of various related activities, including communicating, sharing, and gaining information and experiences online are hard to dispute (K. A. Allen et al., 2014; Moorhead et al., 2013; Skoric et al., 2016), the widespread use of digital media among young people has led to concern among researchers, parents, educators, health promoters, and policymakers about the potential disadvantages of these technologies for adolescents (Clark et al., 2020; Kickbusch et al., 2022). One major concern has been problematic social media use, characterized as a pattern of uncontrolled and compulsive engagement with social media (Lee et al., 2017). Another issue raised by researchers and other relevant stakeholders has been the various harmful, provocative, and risky situations adolescents may encounter through their use of social media, including cyberbullying, sexual harassment, racism, the sale or distribution of drugs, and misinformation (Livingstone & Stoilova, 2021; Ognibene et al., 2022; Stoilova et al., 2023). Problematic social media use and social media threats have been suggested as particularly harmful in adolescence, insofar as youth represents a sensitive period of vulnerability (Clark et al., 2020), a period when wellbeing shows the greatest fluctuation (Maciejewski et al., 2019), and risk-taking is at its peak (Burnett et al., 2011; Steinberg, 2007). Thus, the rapid adoption of digital media among adolescents has led to concern about the potential negative effects of these technologies on adolescent health and wellbeing (Orben & Przybylski, 2019; Twenge, 2020). These concerns primarily stem from two striking patterns: a significant increase in adolescents' digital media use and a simultaneous increase in adolescents' mental health problems over the course of the past two decades (Cosma et al., 2020; Orben & Blakemore, 2023; Twenge et al., 2022).

Despite the considerable attention recently given to the phenomenon, we are still in the early stages of understanding the complex and multidimensional nature of adolescent digital media use, whether digital media use is beneficial or harmful to adolescent health, and who may experience the benefits or harms (Valkenburg, Meier, et al., 2022). This thesis contributes to research on the topic by (i) comprehensively examining adolescents' *patterns of digital media use*, namely the kind of activities adolescents participate in on digital media, and whether the use is problematic (with the focus here being on problematic social media use), (ii) identifying the kinds of *social media threats* faced by adolescents while using social media, and (iii) exploring how patterns of digital media use and encounters with social media threats are associated with various individual and social factors, and with health. A particular focus is on those adolescents who are more vulnerable to maladaptive usage patterns (e.g. problematic social media use) and social media threats. The thesis also examines resources to prevent and counteract problematic social media use, social media threats, and the ensuing negative health consequences. A particular focus will be on Finnish adolescents;

however, country-level comparisons will be reported, since these make it possible to track the situation in Finland compared to other countries, and to create surveillance benchmarks for future research. This thesis will specifically focus on early and middle adolescence. The study of digital media use during these developmental stages is considered important, given that digital media are omnipresent during these periods (Granic et al., 2020), with themes such as self-image, identity, self-discovery, the need to belong to a group, and vulnerability emerging as particularly prominent (Backes et al., 2019; Granic et al., 2020).

This thesis is based on four original research articles referred to as Studies I–IV. Together, the four studies extend earlier findings by investigating the complex nature of adolescent digital media use and related factors, thus contributing significantly to the literature on adolescent digital media use, digital equity, and health. The insights gained from this research have potential societal implications, especially in the development of interventions, educational programmes, and policies aimed at promoting safe and secure digital media use among adolescents.

2 THEORETICAL FOUNDATION

This thesis derived inspiration from the Differential Susceptibility to Media Effects model (DSMM). The DSMM has been designed to explain '(a) why some individuals are more highly susceptible to media effects than others, (b) how and why media influence those individuals, and (c) how media effects can be enhanced or counteracted' (Valkenburg & Peter, 2013, p. 221). The DSMM combines, expands, and systemizes previous individual-level media-effects theories, while also utilizing several other theories to better understand media effects (Valkenburg & Peter, 2013). The DSMM consists of an integrated set of four propositions that set out the relationship between media and non-media variables. The first proposition asserts that media effects are dependent on three types of differential susceptibility variables, encompassing *dispositional*, *developmental*, and *social* susceptibility. Gender, personality traits, moods, cognitions, values, and motivations (i.e. personal dimensions) are all examples of dispositional susceptibility variables. Emotional, social, and cognitive development belong to developmental susceptibility, while all social-context factors come under social susceptibility (Valkenburg & Peter, 2013). The second proposition involves the notion that cognitive, emotional, and excitative response states mediate the association between media use and media effect. The third proposition claims that the differential susceptibility variables have two roles, working as *predictors* and *moderators*, while the fourth proposition asserts that media effects are transactional (Valkenburg & Peter, 2013). In this thesis, dispositional and developmental susceptibility variables are referred to as *individual* factors, and social susceptibility variables as *social* factors.

Considered specifically, inspiration for this thesis was derived from propositions one, three, and four of the DSMM. Based on these propositions, in the present study, the individual and social factors were expected to be associated with and to explain patterns of digital media use and social media threats. Furthermore, the patterns of digital media use and social media threats were expected to be associated with various health outcomes (Beyens et al., 2020, 2021; Valkenburg et al., 2021; Valkenburg, Meier, et al., 2022). Some of the individual and social factors were expected to moderate between other

individual/social factors and the patterns of digital media use (Valkenburg & Peter, 2013). Separately from the DSMM, but based on previous literature, individual and social factors were expected to moderate the associations between patterns of digital media use and health outcomes (Johannes et al., 2022).

In recent years, a person-specific approach has been suggested as a paradigm to study individual and social differences with regard to digital media and related effects (Beyens et al., 2024; Valkenburg, 2022; Valkenburg et al., 2021). The reasoning behind this is that consideration of merely the average relations between digital media and, for example, health is not sufficiently informative, given that digital media use differs from adolescent to adolescent (Beyens et al., 2020). Although highly important, the estimates provided by a person-specific approach can be effectively generalized to only a given individual (Molenaar, 2013). Alternatively, when – as in the present thesis – the goal is to make inferences regarding a group (e.g. in identifying vulnerable populations), group-level estimations are needed (while bearing in mind the limitation that a group-level effect does not automatically translate to all members of the group) (Bryan et al., 2021; Johannes et al., 2022). Although the DSMM derives from earlier micro-level media effects theories (Valkenburg & Peter, 2013), and has been primarily used in both within-person and longitudinal investigations (e.g. Beyens et al., 2020, 2021), it has also been successfully used in group-level investigations and cross-sectional settings (e.g. van Duin et al., 2021).

3 REVIEW OF THE LITERATURE

3.1 Patterns of digital media use and social media threats among adolescents

To date, a significant portion of research has focused on adolescent digital media use through the lens of digital screen time (Hietajärvi, 2021; Kaye et al., 2020; Nesi et al., 2022; Valkenburg, 2022). However, this unidimensional concept does not consider the active role of the individual involved (including the various activities adolescents participate in) or the variation in the content adolescents are exposed to. This thesis builds on the notion that understanding the variations in adolescents' interactions with digital media holds greater significance than mere screen time, counted in minutes (Eynon & Malmberg, 2011; Hietajärvi et al., 2019; Valkenburg, Meier, et al., 2022). For this reason, adolescent digital media use was seen as best reflected through patterns of use (involving participation in digital media activities, problematic social media use) and exposure to social media threats. In the following subsections, I shall review the previous literature on adolescent digital media use from these perspectives.

3.1.1 Adolescent participation in digital media activities

Adolescents tend to gravitate toward digital media activities that align with their age-related psychosocial development, schemata, and understanding (Orben et al., 2020; Valkenburg & Cantor, 2000). The most common digital media activities among adolescents are chatting and online communication, which predominantly revolve around close friends and larger existing friend groups (Lyyra et al., 2022; Orben et al., 2020). Adolescents are also devoted users of social networking sites, consistently engaging in activities such as liking, sharing, posting, commenting, and following what peers are doing (Boer, 2022). These activities align with adolescents' need for connection, their need to be seen (i.e. get attention, feel validated), their need to express themselves, and their need to document their experiences (i.e. to document important moments to remember

afterwards) (Romero Saletti et al., 2022; van der War et al., 2022). These features allow young to maintain a sense of belonging and to access support during difficult times (Anderson & Jiang, 2018). Furthermore, adolescents commonly use digital media for general leisure and entertainment, participating in activities such as gaming, listening to music, and watching videos related to their interests and hobbies (Hietajärvi et al., 2019). Another popular activity includes searching for and maintaining information on current events, interests, hobbies, and schoolwork (Hietajärvi et al., 2019; van der War et al., 2022).

Adolescent digital media activities can be classified into active use and passive use (Kross et al., 2020; Subrahmanyam & Michikyan, 2022; Valkenburg, van Driel, et al., 2022; Verduyn et al., 2017). Active use involves direct, individual interactions, including personal messaging or broadcasting (e.g. posting status updates), whereas passive use is characterized by observing other people's online activities without direct engagement (e.g. browsing or viewing the profiles of other users) (Valkenburg, van Driel, et al., 2022; Verduyn et al., 2020). Active and passive use can be divided into private active use (e.g. sending private messages), public active use (e.g. posting status updates), private passive use (e.g. reading private messages), and public passive use (e.g. scrolling through feeds and viewing posts) (Valkenburg, van Driel, et al., 2022). Another way of viewing adolescent digital media activities has been by categorizing them into reciprocal activities (i.e. interactions on digital media platforms where users engage in reciprocal exchanges, responding and reacting to one another) and parallel activities (i.e. activities that occur without reciprocity or eliciting responses from other users) (Nesi et al., 2022; Subrahmanyam & Michikyan, 2022). Digital media activities have been further classified based on participation channels, including devices (e.g. smartphone, tablet), types of applications (e.g. social networking sites, instant messaging), branded applications (e.g. Instagram, WhatsApp), and features (e.g. status updates, creating profiles, messaging) (Meier et al., 2021).

Adolescent digital media activities have been explored via person-oriented approaches aimed at identifying different types of digital media users. For example, the cross-sectional and longitudinal investigations of Hietajärvi et al. (Hietajärvi, 2019; Hietajärvi et al., 2016, 2019) and Maksniemi (2023) conducted on Finnish adolescents from elementary, secondary, and high school levels and from higher education explored the frequency of adolescent socio-digital engagement (i.e. activities related to social media use, internet use, and gaming) and identified six 'participation profiles'. The identified participation profiles were social-networking-oriented participation (oriented towards socializing with friends), knowledge-oriented participation (oriented towards gaining and sharing information related to one's interests), media-oriented participation (oriented towards the complex and towards long term activities such as creating and sharing pictures, videos, and music), action gamers (oriented towards adventure games, role-playing games, and first-person shooter games), social gamers (oriented towards games with social motives such as exercise and fun games), learning-oriented participation (oriented towards personally- or jointly-initiated self-organized study activities), and (among high school students) a

separate blogging-oriented form of participation (oriented towards activities relating specifically to blogging) (Hietajärvi, 2019; Hietajärvi et al., 2019; Maksniemi, 2023).

The participation profiles identified by Hietajärvi (2019) and Maksniemi (2023) share similarities with the three 'genres' of digital media activity identified via a year-long ethnographic investigation on adolescents aged 12–19 (Ito et al., 2010). These genres were friendship-driven 'hanging out' (motivated by the need to keep up and deepen friendships and social connections) interest-driven 'messing around' (motivated by experimental play and fortuitous searching), and creatively oriented 'geeking out' (intensive commitment to and engagement with technology, often involving one particular genre, type, or medium of technology, gaming, or creative production) (Ito et al., 2010). Scholars note that friendship-driven activities primarily involve interactions with existing friends, whereas interest-driven activities revolve around shared interests and frequently include engagement with broader social and knowledge networks (Hietajärvi et al., 2019; Ito et al., 2010). It has also been noted that most adolescents fluctuate across diverse forms of digital activities (Hietajärvi, 2019). In a similar manner to individual digital media activities, 'participation profiles' and 'genres' line up with adolescent self-reported motives for using digital media, including the need for connection, entertainment, inspiration, and information (Romero Saletti et al., 2022; van der Wal et al., 2022). The approaches by Hietajärvi et al. (2019), Maksniemi (2023), and Ito et al. (2010) were among the first to investigate the underlying multiple dimensions of digital media activities among adolescents.

3.1.2 Problematic social media use among adolescents

While various digital media activities have been recognized as behaviours that are typical of and beneficial for contemporary adolescents, there has been growing concern over compulsive and uncontrolled engagement with social media, often referred to as problematic social media use (Andreassen, 2015; Boer, 2022). Stated briefly, problematic social media use is characterized with symptoms of addiction to social media, such as preoccupation, tolerance, and withdrawal (van den Eijnden et al., 2016). Adolescents who display problematic social media use struggle to control their use, often find social media consuming their thoughts, dislike anything that disrupts their social media use, and persist in upholding this behavioural pattern despite unwanted consequences such as relational conflicts (Andreassen et al., 2016). Viewed in this light, problematic social media use qualitatively and conceptually differs from intensive social media use, given that adolescents can spend many hours on social media for numerous reasons without addiction-like symptoms (Boer et al., 2021). Another key distinction between problematic social media use and intensive social media use is that the former, in contrast to the latter, is systematically associated with unfavourable consequences among adolescents (Boer et al., 2020, 2021; Boniel-Nissim et al., 2022). In the international Health Behaviour in School-aged Children study (HBSC), 7% of 11-, 13-, and 15-year-olds reported problematic social media use cross-nationally in 2018 (Inchley et al., 2020). Along similar lines

in Finland, 9% of adolescents could be categorized as problematic users, and 34% as at risk of developing problematic use (L. Paakkari et al., 2021). However, one must bear in mind that some variation in the prevalence rates exists across the literature, depending on the measure adopted.

Various measurement scales have been developed to assess problematic social media use. Among these, the Bergen Social Media Addiction Scale (Andreassen et al., 2016) is one of the most widely used, covering six items that parallel the core criteria of behavioural addictions, including tolerance, withdrawal, preoccupation, persistence, escape, and conflict (Andreassen et al., 2016; van den Eijnden, 2016). However, this conceptualization may not fully capture the negative impact of problematic social media use on daily life—an essential aspect of addiction-like behaviours (Boer, van den Eijnden, et al., 2022; Kardefelt-Winther et al., 2017; van Rooij et al., 2018). In this thesis, the nine-item Social Media Disorder (SMD) scale was adopted to measure problematic social media use (van den Eijnden et al., 2016). The SMD scale includes the six core criteria of addiction (as in the Bergen scale), plus three additional criteria that measure displacement of activities, problems in important life domains, and deception. Hence, the SMD scale is aligned more closely with the scholarly and clinical definition of behavioural addictions, while maintaining a focus on the social media context without overly broadening the definition (Boer, van den Eijnden et al., 2022; van den Eijnden et al., 2016). Although problematic social media use is not recognized by the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) as a behavioural addiction, these nine criteria listed above reflect the criteria for internet gaming disorder listed in the appendix of DSM-5 (American Psychiatric Association, 2013; Lemmens et al., 2015; Männikkö et al., 2015). The inclusion in DSM-5 of problematic social media use as an addictive behaviour has been debated (Boer, 2022; Kardefelt-Winther et al., 2017; van Rooij et al., 2018). Social media use is a relatively recent phenomenon; it increased significantly after the widespread adoption of smartphones around 2012 (Twenge et al., 2018), a period during which the DSM-5 was already in development. It typically takes several decades before a disorder is formally acknowledged and integrated into classification systems.

3.1.3 Social media threats among adolescents

In recent years, some serious negative implications related to adolescent social media use have been repeatedly highlighted, pointing at various problematic social media situations or social media threats. These range from much-discussed problems such as cyberbullying, sexual harassment, and misinformation to more youth-specific issues such as harmful social media challenges (Ognibene et al., 2023). It has been argued that the adolescent developmental stage (involving, for example, heightened susceptibility to risk-taking behaviour) (Steinberg, 2007), in conjunction with the particularly intense use of social media within this age group (Staksrud et al., 2013), places adolescents in a vulnerable situation regarding social media threats (Ognibene et al., 2023; Smahel et al., 2014, 2020). Research has rapidly emerged on these threats as they affect young people, and

on their unfavourable consequences. These investigations have explored the threats either individually, or by categories, such as those with direct or indirect consequences on adolescent health (Smahel et al., 2014, 2020), or as those related to engaging and being exposed to harmful content, experiencing or becoming targeted by harmful contact, witnessing, participating or being a victim of harmful conduct, or being a party to or exploited by a harmful contract (Livingstone et al., 2021; Stoilova & Livingstone, 2023). Regardless of the classification, the authors agree that social media threats are overlapping and interconnected, and that none of the classifications should be perceived as rigid (Livingstone et al., 2024; Ognibene et al., 2023; Smahel et al., 2014, 2020). In line with this, certain threats, such as those related to advanced technological features (e.g. artificial intelligence) and privacy violations have been referred to as 'cross-cutting' threats that intertwine with many other online risks (Livingstone et al., 2021; OECD, 2021; Stoilova & Livingstone, 2023).

Social media threats related to content include physically harmful and violent material (Smahel et al., 2020), appearance-focused content (e.g. on ways to be thin) (Vandenbosch et al., 2022), drug-related content (involving sale, distribution, and misuse) (Fuller et al., 2023), racism (e.g. hate messages attacking certain groups) (Tao & Fisher, 2022), sexually explicit content (e.g. pornography) (Smahel et al., 2020), and harmful and dangerous social media challenges (Vannucci et al., 2020). Furthermore, adolescents face a massive surge in rapidly-spreading misinformation (here referred to as any information that is inaccurate or misleading relative to the best scientific evidence) (Southwell et al., 2022, 2023). This was clearly evident during the COVID-19 pandemic, when a tsunami of information on the coronavirus (i.e. an infodemic) spread rapidly on various social media platforms (Zarocostas, 2020). According to the EU Kids Online survey in 2020, 8%–17% of adolescents aged 12–16 in Europe report having faced harmful online content at least monthly. Approximately 10% of adolescents mentioned having come upon content on experiences of taking drugs, how to commit suicide, or how to physically harm or hurt oneself, while 12% had come upon content on 'ways to be very thin' at least monthly (Smahel et al., 2020).

Concerns have been voiced about adolescent exposure to online sexual harassment conducted by adults on social media. This includes undesired and unsolicited sexual requests, messages, or images, or having them shared without one's consent (Powell & Henry, 2019; Reed et al., 2019). Such harassment could also involve forms of sexual coercion and extortion (Stoilova et al., 2023). For instance, researchers have documented instances in which individuals were coerced into sharing images or engaging in sexual activities online under the impression that the other person had feelings for them, and that they were in a relationship (Stoilova et al., 2023). Furthermore, sexual content can be shared, distributed, and made public without the sender's consent, leading to the risk of unauthorized distribution of sensitive material (Powell & Henry, 2019). In view of the easily accessible nature of the material (whereby any individual can interact with any other) and the broad audience reach, scholars have taken the view that the social media platforms have increased online sexual harassment

beyond the oversight of parents (Smahel et al., 2020). In 2020, 17% of European adolescents aged 12–16 had experienced unwanted sexual requests, 22% had received sexual messages (videos, images, words) and 6% had sent sexual messages over the last year (Smahel et al., 2020).

Social media threats can relate to how adolescents behave in peer-to-peer exchange, and they involve exposure to and participation in cyberbullying— defined broadly as bullying via electronic means (Englander et al., 2017; Kowalski et al., 2014)— and peer sexual harassment (Powell & Henry, 2019; Reed et al., 2019). According to researchers, these platforms allow peer perpetration from any place and at any time, via 24/7 accessibility, both publicly and privately (Campbell, 2013). Moreover, the possibility of remaining anonymous on social media can embolden perpetrators to continue victimization, with less fear of repercussions (Castaño-Pulgarín et al., 2021; Hutson et al., 2018; Reed et al., 2019). The absence of in-person (i.e. face-to-face) cues on social media obscures the negative consequences of victimization (Slonje et al., 2013), and without this critical feedback, aggressive behaviour may be more likely to recur (Barlett et al., 2012; Craig et al., 2020). Repeated exposure to online aggression can lead adolescents to perceive this behaviour as more acceptable due to reinforcement and role modelling, especially if it is socially rewarded (Boniel-Nissim & Sasson, 2018; Craig et al., 2020). Smahel et al. (2020) note that 14% of adolescents in Europe aged 9–16 report being an aggressor themselves, whereas 23% report being a victim of aggression (either on- or offline). According to a recent systematic review, the cross-study prevalence of cyberbullying victimization among adolescents is between 14% and 58%, the variation being explained by, for example, the measures used and the study context (Zhu et al., 2021).

Social media threats arise when agreements with digital providers bind adolescent in ways that are unfair or exploitative, or that pose security, safety, or privacy risks (Livingstone & Stoilova, 2021; Stoilova et al., 2023), bearing in mind that 'acceptance' of the provider's terms and conditions may be unintentional or involuntary. Stoilova et al. (2023) show that third party attacks, including phishing, scams, hacking, fraud, identity theft, data theft, and misuse of personal data, are also a concern. They note that 'children are an easy target for online fraudsters and hackers because they often have easy access to the internet, but only minimal knowledge of the risks'. Moreover, recent studies suggest that in the Europe, a significant number of young individuals (between the ages of 16 and 19) themselves engage in cybercriminal activities. Roughly half of the 8000 individuals surveyed admitted to engaging in activities that could be deemed criminal in certain jurisdictions, such as hacking and fraud (Davidson et al., 2022). Furthermore, 12% of the respondents had used dark web forums, and 11% had utilized darknet markets, known for the sale of illegal goods (Davidson et al., 2022). Initial evidence further points towards increased use of social media to buy or sell drugs, as these media facilitate easy access to groups where the products are distributed, and allow contactless deliveries to end-consumers (Fuller et al., 2023).

3.2 Individual and social factors explaining digital media use

According to the DSMM (Valkenburg & Peter, 2013), and recent cross-sectional (Boer, 2022) and longitudinal evidence (Beyens et al., 2020, 2021), various individual and social factors are relevant to the patterns of digital media use and social media threats among adolescents (Stavropoulos et al., 2022). Consequently, researchers and stakeholders have called for approaches to identify (i) adolescents who are more likely to use digital media in ways that benefit them, and (ii) adolescents who are vulnerable to maladaptive patterns of use (notably problematic social media use) and exposure to social media threats (Clark et al., 2020; Kickbusch et al., 2021).

It has been hypothesized that adolescents who are in favourable situations offline are likely also to flourish online; also that adolescents' offline vulnerabilities correlate with online vulnerabilities (according to the hypothesis that 'the rich get richer') (Bouchillon, 2020; Kickbusch et al., 2021; Stavropoulos et al., 2022). Hence, the studies conducted for this thesis set out to examine the patterns of adolescent digital media use and exposure to social media threats, together with a comprehensive set of individual and social factors. There was a particular focus on factors that might make adolescents vulnerable to maladaptive usage patterns, or act as resources to prevent or counteract these patterns. The factors under investigation were (i) individual factors, including age, gender, academic achievement, health literacy, depressive feelings, and emotional intelligence, and (ii) social factors, including family affluence, family support, friend support, and parental monitoring. In the following subsections, I shall review the previous literature considering these associations.

3.2.1 Individual factors and digital media use

Individual factors correlate with the patterns of adolescent digital media use and play a pivotal role in explaining how adolescents encounter social media threats. Past research has shown that, as compared to their 11-year-old counterparts, adolescents aged 13 and 15 are particularly active in digital media activities such as online communication (Lyyra et al., 2022) and following friends' profiles, pictures, and updates (Hietajärvi et al., 2019). They are also more likely to exhibit problematic social media use (Boniel-Nissim et al., 2022, 2023). Similarly, adolescents aged 15–16 are more likely than adolescents aged 9–14 to report encounters with various social media threats, including harmful and provocative content, cyberbullying, and sexual harassment (Smahel et al., 2020; Staksrud et al., 2013). The higher prevalence of problematic social media use and social media threats among older adolescents (aged 15–16), may stem from heightened use of social media for self-representation and for the development of social self-identity, as well as from increased susceptibility to peer pressure, a desire to connect with deviant peers and communities, and a need to satisfy risk-taking tendencies (Backes et al., 2019). Another explanation could be that older adolescents in general spend more time on digital media, which naturally

increases the chance of entering into maladaptive usage patterns and encountering social media threats (Boer et al., 2020; Ognibene et al., 2023).

Gender is another factor which, according to research (e.g. Twenge et al., 2022), and the DSMM model (Valkenburg & Peter, 2013), explains adolescent digital media use. Studies show, for example, that girls are more likely than boys to participate in friendship-driven communication with close friends and social networking (Lyyra et al., 2022; Smahel et al., 2020). Conversely, boys are more likely to participate in online gaming (Smahel et al., 2020). Cross-national findings indicate that girls are more likely than boys to show higher levels of problematic social media use, although the differences are often small, and national variation exists (Inchley et al., 2020). For example, in Finland, problematic social media use is equally distributed between boys and girls, although girls are more likely to belong to a risk group for developing problematic social media use (Lahti & Paakkari, 2023; L. Paakkari et al., 2021). Variation also exists as regards social media threats. For example, girls are more likely to report exposure to online sexual harassment (Savoia et al., 2021; Ståhl & Dennhag, 2021) and to encounter appearance-focused social media content (Choukas-Bradley et al., 2022; Marengo et al., 2018), whereas boys are more likely to report violent material (Smahel et al., 2020), and to have a lower risk perception regarding privacy and the sharing of sensitive information (Lareki et al., 2017). The differences in the usage patterns and threat exposure between boys and girls can be attributed to many cultural and developmental factors, including societal norms, gender roles, and peer influence processes (Savoia et al., 2021; Valkenburg & Piotrowski, 2017).

School-related factors have also been associated with adolescent digital media use. For example, Hietajärvi (2019) demonstrated that adolescents with an indifferent academic goal orientation (referring to those who acknowledge the importance of learning and of doing well in school but who are reluctant to invest effort in attaining these goals) are more likely to participate in various social media activities and in online gaming. Previous research further shows that adolescents with low academic achievement are more likely to report maladaptive patterns of use, including problematic social media use (L. Paakkari et al., 2021; Yıldız Durak, 2020). Adolescents struggling academically may be drawn to digital media because it allows them to escape from feelings of stress, anxiety, and inadequacy (Hietajärvi, 2019). Such feelings could serve a foundation for problematic social media use (Shannon et al., 2022). At the same time, there are several lines of reasoning that propose a reciprocal relationship. It is argued that digital activities such as social networking (which involves managing multiple social media feeds) elevates the daily cognitive load; this leads to a decline in academic performance due to an imbalance between psychological demands and the resources allocated to them (Alt, 2018; Oberst et al., 2017).

Health literacy has been recognized as an important and modifiable correlate of adolescent digital media use (Lyyra et al., 2022; O'Neil, 2019; O. Paakkari & Paakkari, 2023). According to the World Health Organization (WHO)

health literacy refers to a set of skills that enable people to access, evaluate, appraise, and use services and information, and to exercise critical judgement in ways that promote and maintain good health and wellbeing for themselves and those around them (World Health Organization, 2021). It empowers individuals to make sustainable and informed health-promoting decisions (Nutbeam & Muscat, 2021). Research shows that adolescents with higher health literacy are more likely to participate in friendship-driven digital media activities such as communicating with close friends (Lyyra et al., 2022) and seek health information from credible sources online (Chang et al., 2015; Chen et al., 2018; Ghaddar et al., 2012; Southwell et al., 2023). Moreover, they are less likely to report problematic social media use whereas adolescents with low health literacy are more likely to report problematic social media use (L. Paakkari et al., 2021; O. Paakkari & Paakkari, 2023). Health literacy can be developed through education and intervention (World Health Organization, 2021); hence it belongs to the potentially modifiable factors that can contribute to reducing unfair and avoidable disparities during adolescence. This strand of research shows the potential of health literacy to act as a resource (i.e. moderator and a mediator), promoting positive health, and protecting adolescents from negative health and health behaviour (L. Paakkari et al., 2019; Pelikan et al., 2018).

Another significant individual factor associated with adolescent digital media use is depressive feelings. In a longitudinal investigation by Puukko et al. (2020), the researchers observed that depressive feelings predicted a small increase in adolescent social media activities related to chatting, sharing photos, status updates, and posting personal content. Moreover, adolescents with depressive feelings are more likely to report problematic social media use (L. Paakkari et al., 2021; Raudsepp & Kais, 2019). The reason may be that those with depressive feelings often grapple with emotional distress and interpersonal difficulties (J. P. Allen et al., 2006). For these adolescents, social media may offer an escape from perceived psychosocial problems, for example, by allowing them to alleviate distress and connect with others online (Gross et al., 2002; Valkenburg & Piotrowski, 2017). Using social media as a coping mechanism and preferring online communication to face-to-face interaction may lead to unhealthy beliefs about social media, and result in problematic social media use (Boer, 2022; Wu et al., 2013). It is nevertheless unclear whether depressive feelings are the cause or the result of digital media use (Hartanto et al., 2021). In this thesis, depressive feelings are considered from both of these perspectives, seeking to gain a more holistic understanding of the relationship, and bearing in mind that the relationship could be bidirectional (Frison & Eggermont, 2017; Hartanto et al., 2021).

There is a growing body of research suggesting that adolescents with higher emotional intelligence report lower exposure to maladaptive patterns of digital media use and social media threats (Arrivillaga et al., 2022; Incardona et al., 2023). Emotional intelligence refers to the ability to recognize and understand personal emotions and the emotions of others, and to use this knowledge to manage one's own actions and interpersonal relationships effectively (Salovey & Mayer, 1990).

Indeed, studies have accumulated on the role of emotional intelligence in protecting adolescents against problematic social media use (Arrivillaga et al., 2022) and cyberbullying (Zych et al., 2019). Conversely, adolescents with low emotional intelligence are likely to be at a higher risk for problematic social media use (Arrivillaga et al., 2022), and for social media threats, as has been shown in previous studies (Ang et al., 2010; Marín-López et al., 2020).

3.2.2 Social factors and digital media use

In parallel with individual factors, various social factors play a substantial role in explaining adolescent patterns of digital media use and exposure to social media threats. Research has shown that adolescents from less affluent families are more likely to participate in activities such as passively viewing content and playing online games, and are less likely than their more affluent peers to use digital media for information searches and learning purposes (OECD, 2016). In a study by Lenzi et al. (2022) adolescents who were relatively more deprived than their peers were more likely to report problematic social media use. However, consistent associations between family affluence and problematic social media use in adolescence have not been shown, either by cross-national studies (e.g. Boer, 2022; Inchley et al., 2020) or studies in Finland (e.g. L. Paakkari et al., 2021). Studies on young people have found that those with lower family affluence are more likely to report exposure to social media threats such as having sensitive material shared without their consent and receiving hurtful messages (Skogen et al., 2022, 2023). The prevailing explanation of the link between family affluence, problematic social media use, and social media threats is that socioeconomic stratification creates stark contrasts in social class (Lenzi et al., 2022). This can lead to increased class anxiety, reduced social trust, and intensified upward social comparisons (Cheung & Lucas, 2016). Under these circumstances, adolescents may develop compulsive usage patterns and engage with social media in risky ways in efforts to portray themselves positively to their peer groups (Lenzi et al., 2022; Saunders & Eaton, 2018; Uhlmann et al., 2018).

Given that adolescence represents a period marked by rapid growth and changes, adolescents need diverse sources of social support when experimenting with digital media (Boniel-Nissim et al., 2022). In adolescence, one begins to move away from the family and to approach friend groups to a greater degree (Lam et al., 2014; Orben et al., 2020; Rubin et al., 2006). Nevertheless, family support does not cease to be significant at this stage (Rueger et al., 2016). Adolescents who report higher levels of family and friend support have been shown to demonstrate more beneficial patterns of use, including more frequent online communication with close persons, and a lower likelihood of problematic social media use (Boer et al., 2020; Boniel-Nissim et al., 2022). Conversely, adolescents who lack support from family and friends may be particularly vulnerable to problematic social media use (Boer et al., 2020). These young individuals may be drawn to social media because it allows them to present themselves positively in ways that they find challenging in offline interactions (Boer, Stevens, Finkenauer, & van den Eijnden, 2022). Consequently, they may

develop a preference for online communication over face-to-face interactions. This shift can lead to unhealthy beliefs about social media, such as the notion that the meaning of life is to be found online, which could result in compulsive and uncontrolled usage patterns (Boer, Stevens, Finkenauer, & van den Eijnden, 2022; Caplan, 2003; Davis, 2001). In looking at maladaptive usage patterns, it has been suggested that family support and friend support could have the potential to work as moderators in the associations between other background factors and problematic social media use (Lenzi et al., 2022).

Higher family support has been found to significantly reduce adolescents' risk of encountering social media threats. For example, a review study by Elsaesser et al. (2017) found that higher family support was consistently associated with lower cyberbullying victimization and perpetration. However, the relationship between friend support and social media threats appears to be more complex. On the one hand, a higher level of friend support has been shown to protect young people from social media threats such as cyberbullying (Sherman et al., 2016). On the other hand, friend support can enhance the likelihood of encountering and participating in risky behaviours such as harmful social media challenges (Ward et al., 2021).

Another social factor, i.e. parental monitoring, encompasses the measures taken by parents to oversee the duration and frequency of media use by young people, their activities on these platforms, and their companions during this use (Beyens et al., 2022). Classifications have further been made between active and restrictive monitoring, and, for example, between autonomy-supportive and restrictive styles (Beyens et al., 2022). Generally, higher levels of supportive parental monitoring have been hypothesised to be negatively associated with problematic social media use (Vossen et al., 2024), and to mitigate risks such as exposure to inappropriate content (Tomić et al., 2018) and cyberbullying (Strohmeier & Gradinger, 2022; Wright, 2018). However, the research suggests that stricter control and surveillance-oriented parental strategies can restrict adolescent autonomy, which could result in friction and negative media outcomes (Beyens et al., 2022; Fam et al., 2023; Wright, 2018). Hence, such strategies should be accompanied by parental support to encourage disclosure, along with respect for adolescents' perspectives and autonomy (Odgers & Jensen, 2020). Nevertheless, the association between parental monitoring and digital media use is complex (Fam et al., 2023).

3.3 Digital media use and health in adolescence

In recent times, there has been a huge increase in research on the effects of digital media use on adolescent health (Schønning et al., 2020). This surge may be due to digital media occupying an ever-growing part of adolescents' daily lives (Valkenburg & Piotrowski, 2017), bearing in mind that adolescence is the stage of life in which wellbeing shows most fluctuation (Maciejewski et al., 2019), and in which mental disorders such as depression typically emerge (Keshavan et al.,

2014; Paus et al., 2009). Most existing research has investigated the correlation between digital media use and health via time-based measures covering the overall time adolescents spend on digital media. The observational and empirical evidence from these studies is conflicting. On the one hand, numerous studies (e.g. Barthorpe et al., 2020; Ivie et al., 2020; Kelly et al., 2019; Leventhal et al., 2021; Liu et al., 2022; McAlister et al., 2021; McNamee et al., 2021; Robertson et al., 2022; Shafi et al., 2021; Twenge et al., 2018; Woods & Scott, 2016) have associated time spent on digital media with increased depression, anxiety, and sleep difficulties. On the other hand, an equivalent volume of research (e.g. Boer, 2022; Coyne et al., 2020, Keum et al., 2022; Kim et al., 2020; Orben & Przybylski, 2019, Panayiotou et al., 2023; Przybylski & Weinstein, 2017) has been unable to show convincing evidence of such relationships. Adding to this complexity, some studies have shown digital media as eliciting feelings of happiness, and as having a mainly positive correlation with adolescent health and wellbeing (O'Neil, 2019; Vuorre & Przybylski, 2023; Weinstein, 2018; Wenninger et al., 2019).

There have thus been calls for research to go beyond explaining adolescents' health via the overall time spent on digital media, and to look rather at the associations between health and *how* the time on digital media is spent, including also the content that adolescents are exposed to (Nesi et al., 2022; Valkenburg, Meier, et al., 2022). Accordingly, this thesis investigated how patterns of digital media use and social media threats are associated with adolescent health. Health was investigated via validated instruments covering adolescent self-rated health, life satisfaction, depressive feelings, anxiety symptoms, morning tiredness, and sleep difficulties. Following this approach, the emphasis was on aspects of mental health and on adolescent subjective experiences, bearing in mind the adolescents' ability to accurately report their reflections on their health (Currie et al., 2014; Inchley et al., 2018). The operationalization of health in this thesis incorporated indicators of both wellbeing (life satisfaction) and ill-being (depressive feelings, anxiety symptoms). An emphasis was also placed on sleep, given its critical role in adolescent development (Matricciani et al., 2019; Shochat et al., 2014), and the fact that digital media are often viewed as contributing to insufficient sleep and sleep difficulties, particularly among young people (Mireku et al., 2019; Przybylski, 2019). The thesis adopts two prevailing conceptualizations of health: (i) health as an absence of illness, reflecting a scientific and Western biomedical perspective that essentially adopts a negative stance towards health (O'Neil, 2019), (ii) a more comprehensive definition given by the World Health Organization (World Health Organization, 1946), characterizing health as 'a state of complete physical, mental, and social wellbeing' – hence not merely the absence of disease or infirmity.

Early scholarly on patterns of digital media use and adolescent health has shown that various digital media activities differently explain health outcomes among adolescents. For example, friendship-driven digital media activities, which make adolescents feel more connected to their friends and which foster their sense of social self-identity, seem to correlate with higher self-rated health (Lyyra et al., 2022), life satisfaction (Boniel-Nissim et al., 2022), and mental

wellbeing (Anthony et al., 2023) whereas communication with unknown people tends to have the opposite effect (Lyyra et al., 2022). Moreover, there is an increasing body of evidence suggesting that problematic social media use threatens adolescents' health. For instance, meta-analytic studies and systematic reviews have highlighted the association between problematic social media use and depression and anxiety (Andreassen, 2015; Best et al., 2014; Ivie et al., 2020; Keles et al., 2020; Lopes et al., 2022; McCrae et al., 2017). Problematic social media use has also been linked to sleep difficulties (Boniel-Nissim et al., 2023; Buda et al., 2020), poor self-rated health (L. Paakkari et al., 2021) and lower life satisfaction (Boer et al., 2020; Boniel-Nissim et al., 2022) in adolescence.

Exposure to social media threats has been associated with various negative health outcomes in adolescence. These vary according to the threat type and frequency. So far, most evidence has accumulated on exposure to cyberbullying (Fahy et al., 2016; Li et al., 2022; Marciano et al., 2020; Nixon, 2014), sexual harassment (Reed et al., 2019; Ståhl & Dennhag, 2021; Zetterström Dahlqvist & Gillander Gådin, 2018), and racial discrimination (Tao & Fisher et al., 2023), and on how these are related to increased depressive symptoms, anxiety, and suicidal ideations. Furthermore, an association has been found between anxiety and the unauthorized distribution of sensitive material via social media, which is further related to sexual harassment and cyberbullying (Wang et al., 2019). Depressive feelings and anxiety may increase due to shame, embarrassment, guilt, social isolation, and negative labelling by peers and the broader community (Henry et al., 2021; Wang et al., 2019). Cyberbullying, sexual harassment, racial discrimination, and the unauthorized distribution of sensitive material give rise to a loss of control over personal information, and a sense of powerlessness (Henry et al., 2021; Wang et al., 2019).

Harmful, and provocative content, such as violence, pornography, experiences of taking drugs, ways of hurting oneself, and content inducing appearance pressures (e.g. ways to be thin), has also been proven to be harmful to adolescent health. For instance, encounters with harmful and provocative content have been linked to emotional disturbance, self-harm, and suicidal ideation, especially amongst vulnerable users (Arendt et al., 2019). Idealized appearance-focused content on social media, for its part, provides adolescents with opportunities to internalize prescriptive ideals (such as a V-shaped torso, visible abs for males, and thin and curvaceous ideals for females). Media users may be drawn to self-objectify, and to engage in negative upward appearance comparisons, which could trigger body dissatisfaction (Schreurs & Vandenbosch, 2022; Vandenbosch et al., 2022), and contribute to anxiety and depression (Hawes et al., 2020). Harmful social media challenges – amplified by peer influence processes, including quantifiable reinforcements in the form of likes and comments (see Moreno & Whitehill, 2014; Strasburger 2007) – can result in unhealthy or dangerous behaviour (Vannucci et al., 2020). Furthermore, Nesi et al. (2017) found that adolescents who had seen their peers drinking alcohol on social media were more likely to start binge drinking one year later. Misinformation may erode adolescent judgement, resulting in poor and

unhealthy behavioural choices or inaction (Greene & Murphy, 2021; Morley et al., 2020; Southwell et al., 2023). It may shape the precursors of intention, such as attitudes toward behaviour (approval or disapproval), beliefs regarding subjective norms, and perceptions of one's confidence in executing the behaviour (Fishbein & Yzer, 2003; Southwell et al., 2023). Misinformation has further been associated with anxiety, distress, and depressive feelings (Hamilton et al., 2022; Moreno & Jolliff, 2022; Rocha et al., 2023). Overall, it seems that problematic social media use and encounters with social media threats show a stronger correlation with negative health (and health behaviour) among adolescents than is the case for digital screen time alone (Viner et al., 2019).

The association between digital media use and adolescent health outcomes is likely to be influenced by both individual and social factors. For instance, the association between social media use and depressive feelings has been shown to be stronger among girls than boys (Kelly et al., 2019; Nesi & Prinstein, 2015; Twenge & Farley, 2021; Twenge et al., 2020, 2022). The developmental stage also plays a role, given that for girls, a window of sensitivity for experiencing negative social media effects (e.g. a decrease in life satisfaction) was observed between the ages of 11 and 13, whereas for boys, a similar window was observed between the ages of 14 and 15 (Orben et al., 2022). Previous studies on the role of health literacy (L. Paakkari et al., 2019; Pelikan et al., 2018) and social support (Rueger et al., 2016) in promoting health (and counteracting negative health and health behaviour) suggest that such resources could moderate and possibly counteract the negative health outcomes related, for instance, to problematic social media use.

3.4 The rationale of the study

Current research reveals certain gaps in scholars' understanding. In this section, I shall cover the knowledge gaps that the present work aims to target, both from the Finnish national perspective (since Finland is the primary national context of this study), and from the broader empirical perspective.

In Finland, we lack nationally representative research on the patterns of adolescent digital media use, and are yet to fully comprehend the type of social media threats that adolescents encounter, and how often they are exposed to them. While approaches such as the EU Kids Online survey (Smahel et al., 2020) have been valuable and have provided some insights into Finnish adolescent digital media use, their utility has been lessened by having insufficient and/or non-representative data (marked in the report with an asterisk indicating data limitations). Furthermore, we do not know how various individual factors (such as health literacy and emotional intelligence) and social factors (such as family support and friend support) explain patterns of digital media use and social media threats; nor do we know how patterns of use and social media threats explain various health outcomes among Finnish adolescents. These knowledge gaps pose challenges for national research, education, intervention, and policy in

relation to (i) ensuring safe and secure digital media for adolescents, and (ii) promoting equitable opportunities for advantageous forms of participation, (iii) reducing maladaptive patterns of use and exposure to social media threats.

In a broader empirical context, scholars have argued that while there has been considerable research on adolescent digital media use, it has been limited by over-reliance on measures of digital screen time, and by inaccurate or vague specifications of digital media (e.g. mixing terms interchangeably, broad classifications such as the active and passive use, or from lumping together various activities) (Griffioen et al., 2020; Nesi et al., 2022; Parry et al., 2021; Valkenburg, 2022). While some studies have used more fine-grained measures (covering digital media activities, problematic social media use, and social media threats), few have paid attention to potential fluctuations in usage patterns and threat exposure related to various individual factors and social factors (as proposed by the DSMM; Valkenburg & Peter, 2013). This is problematic, since increased sensitivity to these patterns and threats is likely to occur together with various relevant background factors (Beyens et al., 2024; Orben et al., 2022). It is true that *some* studies under *some* conditions have investigated *some* background factors (most often related to problematic social media use, cyberbullying, and online sexual harassment) as shown in Chapter 3.2; nevertheless, the approaches taken so far have not considered the various patterns of use and the various social media threats in relation to a *comprehensive* set of individual (age, gender, academic achievement, health literacy, depressive feelings, emotional intelligence) and social factors (family affluence, family support, friend support, parental monitoring). This limitation makes it difficult to achieve a true understanding of the complex and multidimensional nature of adolescent digital media use, or to identify those persons who benefit from digital media use, and those for whom it is harmful (Beyens et al., 2020; Piotrowski & Valkenburg, 2015). Furthermore, given that most of the existing evidence base is by nature variable-oriented, more person-oriented approaches have been called for (see Hietajärvi, 2019; Hietajärvi et al., 2019; Ito et al., 2010; Maksniemi, 2023).

Both in Finland, and in the broader empirical context, we are still in the early stages of comprehending how digital media use explains various adolescent health outcomes. As noted above, research considering this association has mostly relied on digital screen time measures (Griffioen et al., 2020; Nesi et al., 2022; Parry et al., 2022; Valkenburg 2022; Valkenburg, Beyens, et al., 2022). Furthermore, the measures of health outcomes have involved theoretical limitations (such as arbitrary choices to collapse distinct wellbeing and ill-being outcomes) and methodological limitations (such as non-validated instruments), and these have affected the reliability of the evidence base (Valkenburg, 2022). To better comprehend how digital media use explains adolescent health, both in Finland, and in the broader empirical context, there is a need for fine-grained measures of patterns of use and social media threats, together with validated, well-established instruments covering many facets of health (Griffioen et al., 2020, Parry et al., 2022, Valkenburg, 2022). This will make it possible to develop a stronger foundation for interventions, policymaking,

education, and health promotion, and will allow us to progress beyond the inconsistent findings related to digital screen time.

It is notable that little attention has been paid to determining and exploring the individual and social factors that could function as *individual and social resources* against the maladaptive patterns bound up with problematic social media use and negative health outcomes (Clark et al., 2020; Kickbusch et al., 2021). It has been suggested that health literacy (World Health Organization, 2021) and family and friend support (Marengo et al., 2021; Rueger et al., 2016) could hold the potential to work as such resources, since these are factors that can be effectively developed through education, interventions, and policy. According to the DSMM (Valkenburg & Peter, 2013), the resources could be modelled as moderator variables to explain systematic variations in, for example, problematic social media use and the associated negative health outcomes. Note that such research should be directed at *all* adolescents, with a particular focus on unequal positions, vulnerable situations, and inequities related to digital media use and negative health outcomes. The aim should thus be that no one is left behind (Clark et al., 2020; Kickbusch et al., 2021).

Studies on digital media use and associated individual and social factors and health outcomes have typically relied on single-country data, leaving unanswered the question of whether these associations are country-specific (Boer et al., 2020). Hence, it remains unclear whether these associations depend upon the national context in which adolescents grow up. Country comparisons are needed to assess (i) where we stand in Finland, (ii) how (compared to other countries) our adolescents use digital media, and (iii) how this use relates to individual and social factors and health outcomes. Furthermore, there is a need to investigate, both within individual countries and cross-nationally, resources against problematic social media use and the ensuing negative health outcomes.

In addition, more research is needed on how patterns of digital media use have changed between different time points, insofar as change is one of the most central components of the digital media (Nesi et al., 2022). For example, given the increasing evidence that problematic social media use threatens adolescents' health (Boer et al., 2020, 2021; Boniel-Nissim et al., 2022, 2023; L. Paakkari et al., 2021), it is important to identify whether problematic social media use is increasing, decreasing, or persisting over time.

4 AIMS OF THE STUDY

The overall study aimed to examine Finnish adolescents' digital media use, together with its associations with individual and social factors, and with health (Figure 1). Digital media use was examined via patterns of use (digital media activities and problematic social media use) and the social media threats that might be encountered. The main empirical research questions addressed in this thesis encompassed the research questions from four original research articles, i.e. Studies I–IV. Specifically, the main research questions (RQs) were as follows:

1. How do Finnish adolescents use digital media? (I, II, III, IV)
   (a) What patterns of digital media use can be identified, and how are they related to different individual and social factors? (I, II)
   (b) What kinds of social media threats do adolescents encounter while using social media, and how are they related to different individual and social factors? (III, IV)
2. How is digital media use associated with health? (I, II, IV)
3. How do individual and social resources moderate the association between (i) individual/social factors and digital media, and (ii) digital media use and health? (II)

The first research question was addressed in Studies I–IV. I wished to go beyond merely assessing screen time and to uncover adolescents' diverse ways of using and being exposed to digital media. The aim was thus (a) to examine patterns of adolescents' digital media use, and hence, to investigate adolescents' *latent orientations towards digital media activities* (via a person-oriented approach) and *problematic social media use*, and (b) to identify important adolescent *social media threats*, and explore the exposure to them. Considered in more detail, the studies aimed to investigate how a comprehensive set of *individual* (age, gender, academic achievement, health literacy, depressive feelings, emotional intelligence) and *social* factors (family affluence, family support, friend support, parental monitoring) might explain patterns of digital media use and exposure to social media threats. In relation to problematic social media use, an additional

aim was to monitor changes in use between 2018 and 2022. The second research question was addressed in Studies I, II, and IV. It was directed at examining the relationship between digital media use and *health* (self-rated health, life satisfaction, morning tiredness, sleep difficulties, depressive feelings, anxiety) in adolescence. The third research question, focused on in Study II, was addressed by testing (i) the moderations of *resources* (health literacy, family support, friend support) between other individual and social factors and problematic social media use, and thereafter (ii) the moderation of these resources between problematic social media use and health outcomes. Study II also applied an internationally comparative approach. The aim was to understand how Finnish adolescents' problematic social media use, the related individual and social factors and health outcomes, and the moderating processes compare with those in five European countries, and cross-nationally.

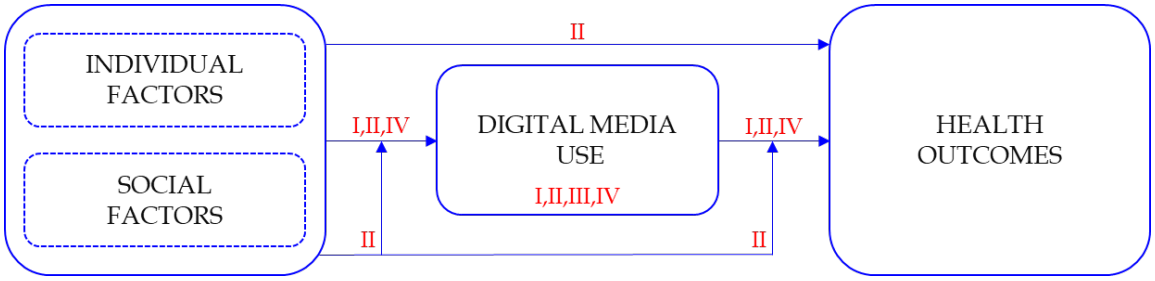


FIGURE 1 The theoretical framework of the study. The numbers I–IV refer to the original studies. Inspiration was derived from the Differential Susceptibility to Media Effects Model (DSMM) (Valkenburg & Peter, 2013).

5 DATA AND METHODS

5.1 Data and participants

The data for the current study were collected from adolescents as part of the Health Behaviour in School-aged Children (HBSC) study, and from experts as part of a national Delphi study.

HBSC is a cross-national study conducted every four years in over 50 countries, in collaboration with the World Health Organization (WHO). The aim is to study the health, health behaviour, and lifestyles of adolescents in their social contexts (Inchley et al., 2018, 2020). For this thesis, use was made of large-scale, nationally representative HBSC 2018 and 2022 data from Finland and also of HBSC 2018 International data from Finland, Germany, Estonia, Belgium, Poland, and the Czech Republic (Table 1).

The HBSC data are collected through anonymous standardized questionnaires administered to young people aged 11, 13, and 15. Participation is voluntary, and the data are collected during school hours in a classroom setting. To ensure the international comparability of the data, all countries comply with the HBSC international protocol; hence, they follow the same data collection procedure and sampling method (Inchley et al., 2018). The mean age of the samples must fall within a range of +/−0.5 years from the means, which are set at 11.5, 13.5, and 15.5 years (Inchley et al., 2018). Participants are selected from national school registers using a stratified random cluster sampling design, as described in the HBSC international protocol (Inchley et al., 2018). The primary sampling unit is the school, and the classes from the participant schools are selected randomly. The samples in each age group are nationally representative, and account is taken of the province, municipality, and size of the school.

For this thesis, national Delphi study data (collected between 2020 and 2021) were used. Purposeful sampling was employed to pre-select information-rich participants (Patton, 2002). Specifically, the Delphi study adopted maximum variation sampling (Suri, 2011) to ensure that the participants in the study offered diverse expert perspectives on the phenomenon under investigation. The

identification of the experts followed a procedure outlined by Okoli and Pawlowski (2004). Initially, relevant disciplines, organizations, professions, and skills (from the perspective of social media threats) were identified. Subsequently, potential participants' names from organizational websites or expert publications were sourced. The selected experts were ranked, and a panel was structured to include participants with multiple viewpoints on the topic. The experts chosen for the Delphi study were researchers from the fields of media education, educational science, psychology, health education, and information research, with inclusion also of teachers and principals working in primary and secondary education and in high schools. There were also other proven experts from media fields, plus professionals in the social and healthcare fields, such as psychologists, child psychiatrists, medical doctors, and youth workers. The data collection was implemented via an electronic questionnaire sent to the selected participants by email. Anonymity is a key component of a Delphi study, with the aim of freely facilitating views on the topic; thus, the email was sent to the selected persons with no possibility to trace an answer to a particular individual.

TABLE 1 Data used in the thesis: number of participants, age and gender distribution, and data collection method.

Data	Age	Gender distribution	Data collection
HBSC 2018 (n =3408)	11 (n = 993; 29.1%) 13 (n = 1246; 36.6%) 15 (n = 1169; 34.3%)	Boy (n = 1706; 50.1%) Girl (n = 1702; 49.9%)	Cross-sectional
HBSC 2022 (n = 2288)	11 (n = 904; 39.5%) 13 (n = 764; 33.4%) 15 (n = 620; 27.1%)	Boy (n = 1117; 48.8%) Girl (n = 1171; 51.2%)	Cross-sectional
HBSC 2018 International (n = 22 226) **Finland** (n = 2194) **Germany** (n = 2922) **Belgium** (n = 2688) **Estonia** (n = 3147) **Czech Republic** (n = 7768) **Poland** (n = 3507)	13 (n = 11 036; 49.7%) 15 (n = 11 190; 50.3%) **Finland** 13 (n = 1118; 51.0%) 15 (n = 1076; 49.0%) **Germany** 13 (n = 1405; 48.1%) 15 (n = 1517; 51.9%) **Belgium** 13 (n = 1228; 45.7%) 15 (n = 1460; 54.3%) **Estonia** 13 (n = 1605; 51.0%) 15 (n = 1542; 49.0%) **Czech Republic** 13 (n = 3954; 50.9%) 15 (n = 3814; 49.1%) **Poland** 13 (n = 1726; 49.2%) 15 (n = 1781; 50.8%)	Boy (n = 10 980; 49.4%) Girl (n = 11 246; 50.6%) **Finland** Boy (n = 1091; 49.7%) Girl (n = 1103; 50.3%) **Germany** Boy (n = 1351; 46.2%) Girl (n = 1571; 53.8%) **Belgium** Boy (n = 1345; 50.0%) Girl (n = 1343; 50.0%) **Estonia** Boy (n = 1576; 50.1%) Girl (n = 1571; 49.9%) **Czech Republic** Boy (n = 3924; 50.5%) Girl (n = 3844; 49.5%) **Poland** Boy (n = 1693; 48.3%) Girl (n = 1814; 51.7%)	Cross-sectional
Delphi survey (n = 22)	-	-	Delphi method

Note. The Health Behaviour in School-aged Children (HBSC) data go through strict data cleaning procedures nationally and internationally. These data cleaning procedures ensure the quality and international comparability of the data, and are the reason for the variation in the sample size of the Finnish 13- and 15-year-olds included in the HBSC 2018 data and HBSC 2018 International data.

5.2 Measures

5.2.1 Digital media use

Adolescents' digital media use was measured via questions concerning 1) their participation in various digital media activities, 2) their problematic social media use, and 3) their exposure to social media threats.

Adolescents' digital media activities were assessed using 16 items adapted from the Finnish Some ja Nuoret 2016 study (Ebrand Group Oy, 2016). Respondents were asked to indicate how often they used the internet to read or look at content (browse), 'dig' or 'give thumbs up' to other people's postings (like), listen to music (listen), read or look at what acquaintances are doing (follow), write a blog or other text (blog), look for information (info), comment on interesting things (comment), share different content (share), tell acquaintances what they are doing (post), take or edit pictures (picture), play games (game), get to know new people (know people), look for like-minded company (company), take or edit videos (video), make or edit music (music), and talk on the internet (e.g. via WhatsApp) (talk). The questionnaire utilized a Likert-type scale ranging from 1 = never to 6 = several times every day.

Problematic social media use (PSMU) was measured by using nine items from the Social Media Disorder (SMD) scale (van den Eijnden et al., 2016). Respondents were asked whether they, in the past year, had regularly been unable to think of anything other than social media (preoccupation), had felt dissatisfied because they wanted to spend more time on social media (tolerance), had often felt bad when they could not use social media (withdrawal), had failed in efforts to spend less time on social media (persistence), had regularly neglected other activities because of social media (displacement), had regularly had arguments with others because of their social media use (problem), had regularly lied to parents or friends about their time spent on social media (deception), had often used social media to escape from negative feelings (escape), and had experienced serious conflicts with parents or siblings because of their social media use (conflict). The response options were 0 = no and 1 = yes. Respondents who answered positively 0–5 were classified as nonproblematic users, with scores of 6–9 indicating problematic users (Boer, Stevens, Finkenauer, Koning, & van den Eijnden, 2022; Boer, van den Eijnden, et al., 2022; van den Eijnden et al., 2016). Overall, the scale has been found to be reliable, valid, and cross-nationally comparable in adolescent samples (Boer, Stevens, Finkenauer, Koning, & van den Eijnden, 2022). The internal consistency of the scale was adequate, with Cronbach's alpha ranging from 0.72 to 0.84 in the six European countries in the 2018 data, and calculated at 0.82 in Finland in 2022.

Adolescents' exposure to social media threats was first investigated in a Delphi study (Study III), in which an expert panel identified the most important threats adolescents may encounter on social media. In the HBSC 2022 survey, respondents were asked to indicate how often they were exposed to nine social media threats, namely cyberbullying, sexual harassment, racism, unauthorized distribution of sensitive material, phishing attempts, incorrect or wrong information (misinformation), the sale or distribution of drugs, harmful or dangerous social media challenges, and content causing appearance pressures. The responses ranged from 1 = daily to 5 = never. The response options for 2 (more than once a week), and 3 (at least once a week) were united to represent weekly exposure. The items were then reverse scored: 1 = never, 2 = monthly, 3 = weekly, 4 = daily exposure.

5.2.2 Individual factors

Age (11, 13, 15), and **gender** (boy, girl) were studied by asking respondents to choose the correct alternative (Inchley et al., 2018; Inchley et al., 2020).

Academic achievement was measured by asking respondents to indicate their most recent marks in mathematics and their first language. The responses ranged from 4 = fail to 10 = excellent. The mean value for both marks was calculated and recoded into one of three categories: low academic achievement = 4–7, moderate academic achievement = 7.5–8.5, and high academic achievement = 9–10. The categories were formed according to previous studies (L. Paakkari et al., 2019, 2021).

Health literacy was measured via the 10-item Health Literacy for School-Aged Children (HLSAC) instrument (O. Paakkari et al., 2016, 2019). The respondents were asked about having good information regarding health. They were also asked about their ability to give examples of things that promote health, and about their ability to find health-related information, to follow the instructions given by nurses and doctors, to decide if health-related information is right or wrong, to compare health-related information from different sources, to justify their own choices regarding health, to judge how their own behaviour affects their own health, to judge how their own actions affect the surrounding natural environment, and to give ideas on how to improve health in their immediate surroundings. The responses ranged from 1 = not at all true to 4 = absolutely true. The response values were summed, and the sum score (ranging from 10 to 40 points) was categorised (Study I) or used as a continuous variable (Study II). When using the categorical variable, the responses were recoded into three categories based on a sum score: Low = 10–25, Moderate = 26–35, High = 36–40 (O. Paakkari et al., 2018). The scale has been validated and found reliable (O. Paakkari, 2020). The internal consistency of the items was good, with Cronbach's alpha ranging from 0.83 to 0.96 in the six European countries in the 2018 data.

Emotional intelligence was measured using 10 items from the Brief Emotional Intelligence Scale (Davies et al., 2010). Respondents were asked to indicate if they know why their emotions change, if they can easily recognize their emotions as they experience them, if they can tell how people are feeling by listening to their tone of voice or looking at their facial expressions, if they recognize the emotions people are experiencing, if they seek out activities that make them happy, if they have control over their emotions, if they arrange events that others enjoy, if they help other people to feel better when they are down, if they are able to come up with new ideas when in a positive mood, and if they use good moods to encourage themselves to keep trying in the face of obstacles. The response option ranged from 1 = describes me very poorly to 5 = describes me very well. A mean score (ranging from 1 to 5) was calculated from the items to indicate the adolescents' emotional intelligence. The scale was used as a continuous variable. The scale has been validated and found reliable (Davies et al., 2010) and the internal consistency of the scale was good, with a Cronbach's alpha of 0.89 in Finland in the HBSC 2022 data.

5.2.3 Social factors

Family affluence (i.e. the family's socioeconomic position) was measured with the Family Affluence Scale (FAS) III (Torsheim et al., 2016). FAS III includes six items: ownership of a car, ownership of a dishwasher, having one's own bedroom, number of family computers, number of family bathrooms, and number of family vacations during the past 12 months. The relative family affluence was assessed in line with the suggestions of Elgar et al. (2017) and the HBSC international report (Inchley et al., 2020). FAS III was used as a categorical, dichotomous, and continuous variable depending on the analysis strategy. The computed scores were recoded into three groups (Study I): low family affluence = lowest 20%, moderate family affluence = middle 60%, and high family affluence = highest 20% (according to Elgar et al., 2017; Inchley et al., 2020). The scale was dichotomized (Study II) to represent low family affluence as covering the lowest 20% and high family affluence the highest 80%. This was done to allow appropriate group-level comparisons, bearing in mind adolescents in vulnerable situations and possible inequities (Clark et al., 2020; Kickbusch et al., 2021; Marmot & Bell, 2012). The sum score was used as a continuous variable (Study IV) according to the suggestions of Elgar et al. (2017). The FAS III has been validated and shown to be appropriate in adolescent samples (Torsheim et al., 2016).

Family support was measured using Zimet et al.'s (1988) Multidimensional Scale of Perceived Social Support. Respondents were asked to indicate if their family really try to help them, if they get the help and emotional support they need from their family, if they can talk about their problems with their family, and if their family is willing to help them in decision-making. The response options ranged from 1 = very strongly disagree to 7 = very strongly agree. Family support was used as a categorical variable (Study I) and as a continuous variable (Studies II, IV). To create a categorical variable, the mean score was recoded to indicate low family support = 1–2.9, moderate family support = 3–5, and high family support = 5.1–7 (Zimet, 2016). The scale has been validated (Bruwer et al., 2008; Cheng & Chan, 2004), and has shown good reliability. The internal consistency of the items was very good in 2018 (with Cronbach's alpha ranging from 0.89 to 0.96 in six European countries) and in 2022 (with a Cronbach's alpha of 0.96 in Finland).

Friend support was measured using Zimet et al.'s (1988) Multidimensional Scale of Perceived Social Support. Respondents were asked to indicate if their friends really try to help them, if they can count on their friends when something goes wrong, if they have friends with whom they can share their joys and sorrows, and if they can talk about their problems with their friends. The response options ranged from 1 = very strongly disagree to 7 = very strongly agree. Friend support was used as a categorical variable (Study I) and as a continuous variable (Studies II, IV), depending on the analysis strategy. To create a categorical variable, the mean score was recoded to indicate low friend support = 1–2.9, moderate friend support =3–5, and high friend support = 5.1–7 (Zimet, 2016). The scale has been validated (Bruwer et al., 2008; Cheng & Chan, 2004), and has shown good

reliability. The internal consistency of the items was very good in 2018 (with Cronbach's alpha ranging from 0.91 to 0.97 in six European countries), and in 2022 (with a Cronbach's alpha of 0.96 in Finland).

Parental monitoring was measured via six items addressing adolescents' perceptions of parental monitoring and awareness (Broen et al., 1993). Adolescents were asked to indicate if their mother/father knows their friends, if their mother/father knows how they spend their money, if their mother/father knows what they do after school, if their mother/father knows where they go at night, if their mother/father knows what they do in their free time, and if their mother/father knows what they do on the internet. The response options ranged from 1 = she/he knows nothing to 3 = he/she knows a lot. A sum score covering the monitoring of both the mother and the father was computed and then recoded into three categories: low parental monitoring = the lowest 33.3%, moderate parental monitoring = the middle 33.3%, high parental monitoring = the highest 33.3%, in line with previous research (L. Paakkari et al., 2021; Puupponen et al., 2021). The internal consistency of the items was good (Cronbach's alpha 0.91).

5.2.4 Health outcomes

Self-rated health was measured via a single question on the individual's perception and evaluation of their health (Kaplan & Camacho, 1983). The response options ranged from 1 = poor to 4 = excellent. The self-rated health item was used as a dichotomous variable (Studies I, IV) and as a continuous variable (Study II), depending on the analysis strategy. When it was used as a dichotomous variable, respondents who answered 'poor' and 'fair' were classified as having poor self-rated health, whereas those answering 'good' and 'excellent' were classified as having good self-rated health (in line with L. Paakkari et al., 2021; Torsheim et al., 2018). Self-rated health has been shown to be a robust item (DeSalvo et al., 2006), and valid in adolescent samples (C. D. Allen, et al., 2016).

Life satisfaction was measured via a single question in which respondents used Cantril's ladder to rate their life satisfaction (Cantril, 1965). The response options ranged from 0 = the worst possible life to 10 = the best possible life. Life satisfaction was treated as a continuous variable. The scale has been validated in adolescent samples and has exhibited adequate validity and reliability (Lewin & Currie, 2014).

Morning tiredness was measured with a single question on the individual's perception and evaluation of how often they feel tired when they get up on school mornings. The response options ranged from 1 = rarely or never to 4 = more than 4 times a week. Those who reported being tired rarely or never, sometimes, or 1–3 times a week were classified as not having frequent morning tiredness, whereas those who reported being tired more than 4 times a week were classified as having frequent morning tiredness. The categorization was based on previous studies (Kronholm et al., 2015; L. Paakkari et al., 2021).

Sleep difficulty was measured as part of the HBSC symptoms checklist (Ravens-Sieberer et al., 2008). The respondents were asked to indicate how often they had experienced difficulties in getting to sleep over the last six months. The response options ranged from 1 = rarely or never to 5 = about every day. Sleep difficulty was treated as a continuous variable. The item has been validated in adolescent samples and has shown adequate reliability (Haugland & Wold, 2001).

Depressive feelings (individual factor and health outcome) were measured as part of the HBSC symptoms checklist (Ravens-Sieberer et al., 2008). The respondents were asked to indicate how often they had experienced depressive feelings over the last six months. The response options ranged from 1 = rarely or never to 5 = about every day. Those having depressive feelings rarely, or never, or monthly were classified as not having depressive feelings frequently, whereas those having depressive feelings about every week, more than once a week, or about every day were classified as having depressive feelings frequently. To investigate the reverse-causation perspective (Hartanto et al., 2021), the item was used as an individual factor (Study II). The item was also used as a health outcome (Studies I, IV). The item has been validated in an adolescent sample and has been found to have adequate reliability (Haugland & Wold, 2001).

Anxiety was measured as part of the HBSC symptoms checklist (Ravens-Sieberer et al., 2008). The respondents were asked how often they had experienced anxiety over the last six months. The response options ranged from 1 = rarely or never to 5 = about every day. Those reporting anxiety symptoms rarely, never, or monthly were classified as not having anxiety symptoms frequently, whereas those having anxiety symptoms about every week, more than once a week, or about every day were classified as having anxiety symptoms frequently.

5.3 Data analysis and methods

A variety of statistical methods were employed to answer the research questions in this thesis. The statistical programs used were SPSS 26.0 and 28.0 (IBM Corp, 2019, 2021), Mplus version 8.5 (Muthén & Muthén, 1988–2017) and R-software (R Core Team, 2013). Table 2 outlines the main empirical research questions of the thesis and their data and measures, plus the missing data handling and main analyses utilized. The significance level was set at $p < 0.05$. The hierarchical data structure, the sample weights, and the appropriate control variables were considered in the analyses.

TABLE 2 Research questions (RQs), their data, measures, and main analyses.

Research questions, data and measures	Missing data	Main analyses
RQ1(a) (Studies I, II) Patterns of adolescent digital media use and associations with individual and social factors. **Data: HBSC 2018, HBSC 2022, HBSC 2018 International** **Digital media use:** Participation in 16 internet/social media activities, PSMU. **Individual factors:** Age, Gender, Academic achievement, Health Literacy, Depressive feelings (disposition). **Social factors:** Family affluence, Family support, Friend support, Parental monitoring.	Listwise deletion, Mean imputation.	Latent class analysis, Fixed-effects logistic regression models, Stratified modelling, Generalized linear models, Random-effects meta-analytic pooling.
RQ1(b) (Studies III, IV) Social media threats encountered by adolescents while using social media, and associations with individual and social factors. **Data: Delphi study, HBSC 2022.** **Digital media use:** Nine social media threats, PSMU**. Individual factors**: Age, Gender, Emotional intelligence. **Social factors:** Family affluence, Family support, Friend support.	Multiple imputation.	Three-round Delphi method with qualitative and quantitative processes, Fixed-effects logistic regression models.
RQ2 (Studies I, II, IV) The associations between adolescent digital media use and health. **Data: HBSC 2018, HBSC 2022, HBSC 2018 International.** **Digital media use:** Participation in 16 internet/social media activities, PSMU, Social media threats. **Health outcomes:** Self-rated health, Life satisfaction, Morning tiredness, Sleep difficulty, Depressive feelings, Anxiety.	Listwise deletion, Mean imputation, Multiple imputation.	Stratified modelling, Generalized linear models, Random-effects meta-analytic pooling, Fixed-effects logistic regression models.
RQ3 (Study II) The moderation of individual and social resources in the associations between (i) individual/social factors and digital media use, (ii) digital media use and health. **Data: HBSC 2018 International.** **Digital media use:** PSMU. **Individual factors:** Age, Gender, Depressive feelings (disposition), Health literacy (resource). **Social factors:** Family affluence, Family support (resource), Friend support (resource). **Health outcomes:** Self-rated health, Life satisfaction, Sleep difficulty.	Listwise deletion, Mean imputation.	Stratified modelling, Generalized linear models, Moderator analysis, Random-effects meta-analytic pooling.

Note. In relation to problematic social media use (PSMU), changes in use were monitored between 2018 and 2022. Furthermore, an internationally comparative approach was adopted to understand how Finnish adolescents' PSMU, the related individual and social factors, the health outcomes, and the moderating processes compared with those found in five other European countries and cross-nationally. For these procedures Health Behaviour in School-aged Children (HBSC 2018, HBSC 2022, and HBSC 2018 International) data were used.

Outliers, missing data, and descriptive statistics. To answer the research questions, the data were first screened for multivariate outliers and missing values (Bennett, 2001). Multivariate outliers were individually examined and deleted if it was deemed necessary, for example, if a participant showed an implausible answer pattern, such as all values being at the extremes. Missing data were assessed according to the overall percentage of missing data and the percentage of missing responses for each item. More detailed descriptions of the missing values can be found in Studies I–IV. The randomness of the missing data was evaluated using Little's Missing Completely at Random (MCAR) test. Descriptive statistics (e.g. frequencies, cross-tabulation, Chi-square) were investigated prior to the main analyses.

Statistical analyses. To address RQ1(a), Latent Class Analysis (LCA) was used to explore the adolescent latent orientations to various digital activities from a person-oriented standpoint (Study I). The Bayesian information Criterion (BIC), the Consistent Akaike's Information Criterion (CAIC), the Bootstrapped Likelihood Ratio Test (BLRT), and the Vuong-Lo-Mendell-Rubin (VLMR) likelihood ratio test were used to indicate the best-fitting LCA model. The entropy value was also inspected. Another pattern of adolescent digital media use, i.e. PSMU, was examined through descriptive analyses. Cross-tabulation and Chi-square X^2 tests and fixed-effects logistic regression models were performed to examine the associations of individual and social factors with the LCA profiles in Finland. Generalized linear models were used to examine the association of individual and social factors with PSMU nationally in Finland, and in five other European countries. The results of the countries were pooled by random-effects meta-analytic pooling (Viechtbauer, 2010) to investigate cross-national effects (Study II). More specifically, the regression coefficients of the variables were pooled, and standard errors calculated in order to examine the directions and magnitude of the effect sizes. Tjur's R^2 (Tjur, 2009) was calculated when the outcome was the categorical PSMU.

To address RQ1(b), a three-round Delphi study was conducted to identify the most important social media threats encountered by adolescents (Study III). The Delphi study aimed to reach a consensus among a group of expert participants by integrating both quantitative and qualitative procedures. Pilot testing took place before the study procedures, and between each Delphi round to ensure the usability and comprehensibility of the questions for external participants (Stahl et al., 2023).

The purpose of the first round was to stimulate experts to freely generate ideas on the research topic and generate questionnaire items for the second round (Hasson et al., 2000). It included an open-ended questionnaire in which experts were requested to list social media threats that adolescents may encounter when they use the social media. The responses from the experts were carefully read through by the research team, which consisted of five researchers. The distinct social media threats were listed, and overlaps in the responses were removed. The research team members served as critical friends to each other while going through the expert inputs. This method can be characterized as a critical

discourse among researchers, in which understandings are exchanged and reciprocal critical feedback provided (Smith & McGannon, 2018). The diverse perspectives of the research team members were thus utilized as resources for challenging and broadening the interpretations (Smith & McGannon, 2018). In this way, a broad range of qualitatively differing social media threats were identified. The responses were rephrased as statements for the second round, ensuring loyalty to the original responses (Hasson et al., 2000).

In the second round, the experts were requested to assess the importance of each item on a 7-point Likert scale. The scale for the social media threats ranged from 1 = not at all important to 7 = very important. The responses from the experts were analysed quantitatively, drawing on suggestions made in previous Delphi studies (Hasson et al., 2000; Moynihan et al., 2015). Hence, to identify the most important items, the modes, medians, means, standard deviations, and Z-scores (standardized scores with a sample mean = 0, standard deviation = 1) were examined. Agreement percentages were also inspected. The proportion of respondents who rated an item as among the top x most important items (abbreviated as agree % ≥ x) was determined for different values of x. The most important items were listed and used to formulate a new questionnaire for the final round (i.e. round 3).

In the third round, the experts were asked to select and rank the top eight most important social media threats. Items that did not make it to the top-eight list were assigned a value of 0. The sum scores, the mean, and the agreement percentages were analysed to determine the most important social media threats as per the experts' opinion.

Subsequently, using the HBSC 2022 data, fixed-effects multinomial regression analyses were conducted to investigate the association of individual and social factors with nine social media threats that experts had deemed important (Study IV).

To address RQ2, descriptive analyses and multinomial logistic regression analyses were performed to study the association between LCA profiles (i.e. the latent orientations towards digital media activities) and health outcomes (Study I). Subsequently, stratified generalized linear models and random-effects meta-analytic pooling were used to explore the associations between PSMU and health among adolescents in Finland, in five other European countries, and cross-nationally (similarly to RQ1(a)) (Study II). Adjusted R^2 was used for the continuous health outcomes. Fixed-effects binary logistic regression analyses were performed to study the associations between social media threats and health outcomes (Study IV).

To address RQ3, stratified generalized linear models with interaction terms were performed to test how resources moderate the association between individual/social factors and PSMU, and between PSMU and health outcomes. The analyses were conducted separately for each moderator variable. The tests were done in Finland and in five other European countries (Study II). Random-effects meta-analytic pooling was used to investigate cross-national moderating effects.

5.4 Ethical considerations

All stages of the research adhered to the guidelines of the Finnish National Board on Research Integrity (Finnish Advisory Board on Research Integrity, 2012). The following principles applied to the HBSC data collection, and also to the Delphi study: consent from all participants (and parents/guardians of minors), voluntary participation, a privacy notice compliant with the European Union's General Data Protection Regulation (The European Parliament and the Council of the European Union, 2016), the right to withdraw from the study, anonymous data processing and reporting, and secured data storage (Personal IDs, passwords) on the University of Jyväskylä's network drive. In terms of the HBSC data, the participating countries obtained ethical approval from their institutional ethics committee for the study procedures (Inchley et al., 2018). In Finland, HBSC 2018 and 2022 obtained ethical approval from the University of Jyväskylä Ethical Committee. Furthermore, schools, parents, and children were provided with age-appropriate information about the HBSC study's goal, content, and anonymous procedure, to ensure full understanding and participation. For the Delphi study, the Ethical Committee of the University of Jyväskylä was consulted. It was concluded that an application for ethical approval was not necessary due to the use of anonymous procedures. The dissemination of the findings and communication of the results adhered to ethical principles: accuracy and honesty, transparency, accessibility (bearing in mind that the original Studies I–IV were published in open-access journals), recognition of contributors, and equity (with consideration given to the impact on different populations and the need to reach vulnerable groups). Additionally, the research findings were used to directly benefit the study population and participants. These benefits will be discussed in detail in Chapter 7.3.1.

6 MAIN RESULTS

6.1 Patterns of digital media use and relationships with individual and social factors

6.1.1 Participation in digital media activities and relationships with individual and social factors (Study I)

As a starting point, the thesis sought to address adolescent digital media use in terms of various internet and social media activities, and to examine the latent orientations towards these activities. Based on descriptive analyses, the most prevalent activities (those in which adolescents participated several times a day) were listening to music (43.0%), liking posts (40.4%), and talking online (e.g. via WhatsApp) (40.2%).

The latent orientations toward these activities were investigated via a person-oriented approach, using Latent Class Analysis (LCA). The Bayesian Information Criterion (BIC) implied the feasibility of up to nine classes and the Consistent Akaike's Information Criterion (CAIC) up to eight classes. However, the Vuong-Lo-Mendell-Rubin ratio test (VLMR) provided no evidence in favour of increasing the number of classes beyond five. The nonconvergence of the Bootstrapped Likelihood Ratio Test (BLRT) led to its exclusion. The entropy value was high (>0.85) for all the solutions considered. Based on the substantive information provided by the five-class solution, five internet user profiles were identified: *friendship-driven users* (n = 1163, 36.4%), *irregular users* (n = 799, 25.0%), *abstinent users* (n = 574, 18.0%), *excessive users* (n = 354, 11.1%), and *interest-driven users* (n = 302, 9.5%). The adolescent internet user profiles were further studied by examining the medians and modes of the digital media activities within the profiles (Figure 2).

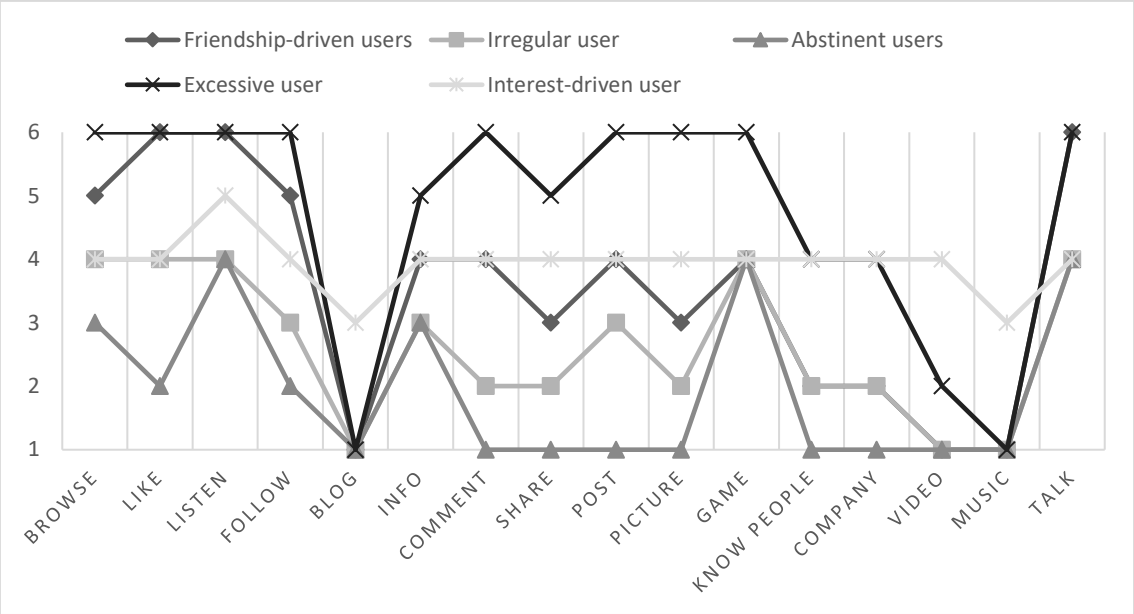


FIGURE 2 Medians for digital activities within the internet user profiles. A scale ranging from 1 = never to 6 = several times every day was utilized.

Friendship-driven users constituted the most prevalent user profile among adolescents. These users demonstrated moderate to high engagement in socially-oriented activities (i.e. from at least several times a week up to several times a day). The activities included talking online, and also other activities facilitated by social media such as liking posts, posting oneself, and following what acquaintances were doing.

Irregular users were the second most prevalent user profile. They reported no particularly high engagement in any digital activity. Based on both medians and modes, their participation in different activities ranged from never to several times a week.

Abstinent users were reflected through their generally low engagement in digital activities (from never to once a week). Among these users, social media facilitated activities such as commenting, sharing, and posting received medians and modes of 1 = never. Thus, abstinent users were overall the least active internet users as regards participating in different digital activities, except for their involvement in listening to music, playing video games, and talking online, in which they reported a median frequency of several times a week.

Excessive users formed the most active internet user profile, participating in many activities, including browsing, liking, commenting, talking online, and gaming, as often as several times a day.

Based on the median values, interest-driven users were reflected through moderate participation (i.e. at least weekly to multiple times a week) in all digital activities; thus, they were overall among the most active groups. The distinguishing feature of this profile was that they reported the highest probability of engaging regularly (up to several times a week) in creative and media-oriented activities, such as editing videos, and making and editing music.

Table 3 presents the individual and social factors applying to adolescents in each user profile. The friendship-driven, excessive, and interest-driven users contained more 15-year-olds than 11-year-olds, whereas irregular and abstinent users contained more 11-year-olds than 15-year-olds. Friendship-driven users contained more girls, whereas interest-driven, irregular, and abstinent users contained more boys. There were more friendship-driven users with high academic achievement than with low academic achievement. All the user profiles contained more adolescents with high health literacy than with low health literacy. Excessive users and friendship-driven users showed the most notable differences in the distribution of those with high health literacy and those with low health literacy with health literacy being notably high in both groups. Furthermore, all the user profiles contained more adolescents with high family support and high friend support compared to those with moderate or low support. However, interest-driven users showed the lowest prevalence of high family support and high friend support.

TABLE 3 The associations of individual and social factors with internet user profiles.

Measure		**Friendship-driven users**	**Irregular users**	**Abstinent users**	**Excessive users**	**Interest-driven users**	
		%	%	%	%	%	*p*-value
	All	36.4	25.0	18.0	11.1	9.5	
Age	15	39.0	23.5	27.5	39.1	40.1	**<.001**
	13	40.0	35.7	32.6	37.7	35.4	
	11	21.1	40.8	39.9	23.2	24.5	
Gender	Girl	66.5	43.6	41.8	52.3	32.1	**<.001**
	Boy	33.5	56.4	58.2	47.7	67.9	
Academic achievement	High	33.1	27.9	22.9	26.7	13.9	**<.001**
	Moderate	47.7	47.3	46.4	43.8	44.2	
	Low	19.2	24.8	30.7	29.5	41.8	
Health literacy	High	39.2	26.0	29.0	49.4	28.1	**<.001**
	Moderate	55.1	66.3	56.6	43.4	57.1	
	Low	5.7	7.7	14.5	7.2	14.8	
Family affluence	High	19.2	16.0	16.2	24.7	18.6	**<.001**
	Moderate	63.1	59.2	56.8	54.7	57.9	
	Low	17.8	24.8	27.0	20.6	23.4	
Family support	High	74.9	76.9	73.0	68.4	58.9	**<.001**
	Moderate	17.9	15.8	18.1	24.2	28.7	
	Low	7.2	7.3	8.9	7.4	12.5	
Friend support	High	74.9	65.3	58.9	73.1	56.0	**<.001**
	Moderate	18.8	24.8	27.5	18.3	31.7	
	Low	6.3	9.9	13.6	8.7	12.4	
Parental monitoring	High	28.5	33.5	30.6	34.1	44.5	**<.001**
	Moderate	34.6	36.6	31.3	29.1	30.2	
	Low	36.9	29.9	38.0	36.8	25.3	

6.1.2 Problematic social media use and relationship with individual and social factors (Study II)

Adolescent problematic social media use was examined via HBSC 2018 International data among 13-and 15-year-olds in Finland, and in five other European countries. The results showed that in 2018, 11.6% of adolescents in Finland, 5.4% in Germany, 7.0% in Belgium, 6.1% in Estonia, 8.7% in Poland, and 5.7% in the Czech Republic were problematic users. Cross-nationally, the prevalence of PSMU was 6.9%. To monitor the changes in problematic social

media use, the prevalence of adolescent PSMU was also inspected in Finland in 2022. Out of Finnish adolescents aged 13- and 15-years old, 10.7% were identified as problematic users in 2022. In contrast with the 2018 finding from Finland (11.6% were problematic users), the 0.9% change was not statistically significant. This finding was not reported in Study II, which means that it is published here for the first time.

Using the HBSC 2018 International data, stratified modelling was performed to identify the associations of individual and social factors with PSMU in Finland (Table 4), in five European countries, and cross-nationally. In Finland, adolescents with frequent depressive feelings (exhibiting a dispositional feature) were more likely to report PSMU, whereas those with higher health literacy and family support were less likely to report PSMU. Similar findings were observed in the other five countries. However, differences between Finland and other countries emerged. For example, in certain countries (e.g. Germany) adolescents aged 13 were more likely to report PSMU than were 15-year-olds, and in certain countries (e.g. Belgium) girls were more likely to report PSMU than were boys. Furthermore, in certain countries (e.g. Estonia) a higher level of friend support was associated with a lower likelihood of PSMU. In the cross-national analyses it was observed that girls, and also adolescents with depressive feelings, were more likely to report PSMU whereas those with higher levels of health literacy were less likely to report PSMU. Out of the social factors, higher levels of family support and friend support were also significantly associated with a lower likelihood of PSMU cross-nationally. The detailed tables covering the findings for the five European countries and the cross-national findings were reported in Study II.

TABLE 4 The associations of individual and social factors with problematic social media use (PSMU) in Finland.

Measure	**PSMU**		
	B	SE	*p*-value
Age (dichotomous)	0.093	0.144	.52
Gender (dichotomous)	0.136	0.151	.37
Family affluence (dichotomous)	0.070	0.171	.68
Depressive feelings (dichotomous)	0.722	0.160	**<.001**
Health literacy (continuous)	-0.031	0.012	**.009**
Family support (continuous)	-0.125	0.043	**.004**
Friend support (continuous)	0.027	0.047	.57

Note. Beta (B), Standard error (SE). Depressive feelings were considered as an individual factor (disposition) in Study II.

6.1.3 Social media threats and relationships with individual and social factors (Studies III, IV)

Adolescent social media threats were first identified through experts' opinions via a Delphi study. Nine of the identified social media threats were then

observationally examined via the 2022 HBSC nationally representative cross-sectional data.

6.1.3.1 Identifying adolescent social media threats (Study III)

In the first round, the Delphi panel was composed of 19 experts. The two open-ended surveys resulted in a list of 125 social media threats that may be faced by adolescents on social media. After a thorough analysis of the qualitative similarities in the content, 29 distinct social media threats were identified and formulated.

In the second round, 22 experts participated. The threats relating to social media were listed in a random sequence to avoid influencing the results. For the subsequent third round, items with a median and mode of ≥6, a mean of ≥5, and a Z-score of ≥−1 were selected. The cut-off criteria were driven by the necessity to have an adequate number of high-importance items for further assessment and selection in the third round. As per the evaluation of the five members of the Delphi research team (including a statistician), a more lenient cut-off would have yielded an excessive number of items, while a more rigorous cut-off would have overly constrained the pool of items. There is no universally accepted cut-off criterion (i.e. golden standard) in the literature (Löfmark & Mårtensson, 2017). The selected cut-off yielded 16 social media threats.

In the final round, the questionnaire was completed by 17 experts. During this round, the experts were tasked with identifying and subsequently ranking the top eight most important social media threats from the remaining 16 social media threats from the second round. The item deemed most important received eight points by the participants, and the item ranked eighth most important received one point, leading to a theoretical maximum of 136 if all the participants had unanimously chosen the same item as the most important. The results indicate that the responses were diverse across the items, but that all the items were included in the lists of the top eight most important items provided by the respondents overall.

To identify the most important social media threats, sum scores were computed. Direct cyberbullying gained a sum score of 102, while exposure to indirect cyberbullying obtained a score of 74. Sexual harassment received a score of 69, and exposure to (i) content causing appearance pressures and (ii) provocative material both received a sum score of 44. Exposure to racism received a sum score of 36. Detailed tables of the identified social media threats are included in Study III.

6.1.3.2 Examination of social media threats and their relationships with individual and social factors (Study IV)

The most prevalent social media threat encountered by adolescents both daily (12.9%) and weekly (44.2%) was misinformation. As regards monthly exposure, the most prevalent social media threats were unauthorized distribution of sensitive material (27.7%) and harmful or dangerous social media challenges

(26.8%). The least common social media threats (i.e. adolescents reported never encountering them) were cyberbullying (79.5%) and sexual harassment (77.7%).

Significant relationships were discovered between individual factors and social media threats. Adolescents aged 15 reported daily and weekly exposure to all the social media threats more than did those aged 11 (Table 5). Similarly, compared to 11-year-olds, 13-year-olds were more likely to encounter six out of the nine social media threats daily, all the social media threats weekly, and eight out of the nine threats monthly. Boys were more likely to report daily exposure to cyberbullying, sexual harassment, racism, unauthorized distribution of sensitive material, phishing attempts, misinformation, and harmful or dangerous social media challenges. By contrast, girls were more likely to report daily exposure to content causing appearance pressures. As regards weekly exposure, boys were more likely to report cyberbullying and phishing attempts, while girls were more likely to report exposure to racism and content causing appearance pressures. Moreover, girls were more likely to report monthly exposure to sexual harassment, racism, misinformation, harmful and dangerous challenges, and content causing appearance pressures. Adolescents with a higher level of emotional intelligence were less likely to self-report daily exposure to cyberbullying, sexual harassment, racism, distribution of sensitive material, or phishing attempts.

TABLE 5 The associations of individual factors with social media threats.

Measure	**Age (ref. 11 y)**				**Gender (ref. boy)**		**Emotional intelligence (continuous)**	
	13 y		**15 y**		**Girl**			
	OR (CI 95%)	*p*-value	OR (CI 95%)	*p*-value	OR (CI 95%)	*p*-value	OR (CI 95%)	*p*-value
Cyberbullying (ref. never)								
Daily	1.62 (0.78–3.35)	.198	2.82 (1.38–5.76)	**.005**	0.28 (0.15–0.53)	**<.001**	0.40 (0.23–0.72)	**.003**
Weekly	2.24 (1.40–3.59)	**<.001**	2.05 (1.26–3.31)	**.004**	0.32 (0.21–0.48)	**<.001**	0.71 (0.44–1.15)	.162
Monthly	1.02 (0.72–1.45)	.892	1.12 (0.79–1.60)	.519	1.10 (0.82–1.48)	.517	0.89 (0.57–1.39)	.605
Sexual harassment (ref. never)								
Daily	1.82 (0.83–4.01)	.135	3.72 (1.89–7.31)	**<.001**	0.51 (0.27–0.96)	**.038**	0.34 (0.17–0.70)	**.005**
Weekly	3.31 (1.98–5.53)	**<.001**	4.43 (2.66–7.36)	**<.001**	0.91 (0.63–1.30)	.601	0.73 (0.47–1.14)	.169
Monthly	2.03 (1.36–3.01)	**<.001**	4.24 (2.95–6.07)	**<.001**	2.53 (1.75–3.64)	**<.001**	0.94 (0.61–1.43)	.753
Racism (ref. never)								
Daily	5.36 (3.06–9.38)	**<.001**	7.19 (4.15–12.45)	**<.001**	0.47 (0.31–0.70)	**<.001**	0.57 (0.36–0.89)	**.015**
Weekly	3.04 (2.23–4.14)	**<.001**	3.52 (2.54–4.87)	**<.001**	1.40 (1.10–1.79)	**.006**	0.80 (0.55–1.15)	.221
Monthly	2.61 (1.98–3.45)	**<.001**	2.92 (2.19–3.90)	**<.001**	1.89 (1.49–2.41)	**<.001**	1.21 (0.82–1.78)	.336
Unauthorized distribution of sensitive material (ref. never)								
Daily	3.15 (1.81–5.49)	**<.001**	5.86 (3.40–10.10)	**<.001**	0.37 (0.24–0.57)	**<.001**	0.57 (0.35–0.94)	**.026**
Weekly	2.87 (2.13–3.88)	**<.001**	4.61 (3.41–6.23)	**<.001**	0.91 (0.71–1.16)	.436	0.92 (0.63–1.33)	.640
Monthly	2.05 (1.60–2.63)	**<.001**	3.04 (2.31–4.01)	**<.001**	1.15 (0.92–1.44)	.215	0.96 (0.65–1.41)	.824
Phishing attempts (ref. never)								
Daily	2.07 (0.98–4.39)	.057	4.78 (2.44–9.38)	**<.001**	0.18 (0.11–0.32)	**<.001**	0.49 (0.29–0.84)	**.010**
Weekly	2.20 (1.56–3.11)	**<.001**	2.79 (1.96–3.96)	**<.001**	0.43 (0.32–0.57)	**<.001**	0.76 (0.49–1.17)	.203
Monthly	1.99 (1.49–2.68)	**<.001**	3.39 (2.59–4.46)	**<.001**	1.16 (0.93–1.45)	.194	1.09 (0.79–1.52)	.601
Misinformation (ref. never)								
Daily	3.29 (2.18–4.97)	**<.001**	5.62 (3.69–8.57)	**<.001**	0.47 (0.34–0.66)	**<.001**	1.03 (0.64–1.65)	.911
Weekly	2.77 (2.07–3.70)	**<.001**	3.73 (2.62–5.31)	**<.001**	1.12(0.87–1.45)	.378	1.22 (0.80–1.84)	.356
Monthly	1.42 (1.04–1.94)	**.028**	1.53 (1.06–2.19)	**.022**	1.34 (1.02–1.75)	**.033**	1.21 (0.73–2.01)	.463
Sale or distribution of drugs (ref. never)								
Daily	7.71 (4.27–13.94)	**<.001**	20.89 (11.86–36.80)	**<.001**	1.08 (0.75–1.54)	.691	0.98 (0.64–1.51)	.928
Weekly	5.21 (3.72–7.28)	**<.001**	11.11 (7.90–15.61)	**<.001**	1.19 (0.90–1.56)	.215	0.92 (0.65–1.31)	.651
Monthly	3.12 (2.24–4.33)	**<.001**	4.95 (3.51–6.98)	**<.001**	1.25 (0.93–1.68)	.133	0.82 (0.56–1.20)	.303
Harmful social media challenges (ref. never)								
Daily	2.00 (1.19–3.38)	**.009**	4.24 (2.58–6.96)	**<.001**	0.42 (0.27–0.65)	**<.001**	0.70 (0.45–1.10)	.123
Weekly	2.55 (1.90–3.41)	**<.001**	3.43 (2.53–4.64)	**<.001**	1.13 (0.89–1.42)	.319	0.85 (0.57–1.27)	.421
Monthly	1.92 (1.48–2.51)	**<.001**	2.58 (1.96–3.39)	**<.001**	1.89 (1.53–2.35)	**<.001**	0.87 (0.59–1.28)	.473
Content causing appearance pressures (ref. never)								
Daily	4.27 (2.70–6.78)	**<.001**	5.85 (3.64–9.42)	**<.001**	6.71 (4.51–9.98)	**<.001**	0.62 (0.35–1.08)	.088
Weekly	3.55 (2.53–4.96)	**<.001**	5.68 (4.12–7.85)	**<.001**	4.79 (3.65–6.29)	**<.001**	0.82 (0.57–1.17)	.276
Monthly	2.93 (2.14–4.01)	**<.001**	2.75 (1.97–3.83)	**<.001**	3.71 (2.84–4.84)	**<.001**	0.87 (0.56–1.35)	.522

Note. Fixed-effects multinomial logistic regression models: odds ratios (OR); 95% confidence intervals (CI); ref. = reference category. Regression models for each social media threat were run separately. Social media threats were treated as outcome variables in the models (see Figure 1) and have been represented on the table rows instead of the columns due to space constraints. The models were adjusted for age, gender, emotional intelligence, family affluence, family support, friend support, problematic social media use, and online communication with strangers. Emotional intelligence was only included for 15-year-olds.

Social factors were also associated with exposure to social media threats. For instance, adolescents from affluent families were more likely to report daily encounters with misinformation and the sales or distribution of drugs (Table 6). They were also more likely to report daily, weekly, and monthly exposure to content causing appearance pressures, and monthly encounters with harmful social media challenges. Adolescents with higher family support were less likely to report daily or weekly exposure to eight out of the nine social media threats,

or monthly exposure to three social media threats. Young people with higher friend support were more likely to report daily encounters with the sale or distribution of drugs, but were less likely to report daily or weekly encounters with cyberbullying.

TABLE 6 The associations of social factors with social media threats.

Measure	**Family affluence (continuous)**		**Family support (continuous)**		**Friend support (continuous)**	
	OR (CI 95%)	*p*-value	OR (CI 95%)	*p*-value	OR (CI 95%)	*p*-value
Cyberbullying (ref. never)						
Daily	1.32 (0.45–3.88)	.605	0.70 (0.57–0.86)	**<.001**	0.78 (0.64–0.94)	**.010**
Weekly	0.76 (0.38–1.53)	.440	0.82 (0.72–0.93)	**.003**	0.75 (0.65–0.85)	**<.001**
Monthly	1.08 (0.64–1.82)	.770	0.92 (0.82–1.03)	.131	0.91 (0.81–1.02)	.088
Sexual harassment (ref. never)						
Daily	0.60 (0.22–1.61	.304	0.60 (0.49–0.72)	**<.001**	0.94 (0.78–1.13)	.507
Weekly	1.22 (0.54–2.79)	.619	0.72 (0.62–0.83)	**<.001**	0.95 (0.83–1.09)	.474
Monthly	1.00 (0.61–1.64)	.997	0.78 (0.70–0.87)	**<.001**	1.05 (0.94–1.17)	.391
Racism (ref. never)						
Daily	1.99 (0.94–4.19)	.071	0.78 (0.67–0.90)	**<.001**	1.00 (0.87–1.16)	.974
Weekly	1.00 (0.61–1.63)	.983	0.86 (0.78–0.94)	**<.001**	0.96 (0.87–1.05)	.311
Monthly	1.04 (0.69–1.58)	.848	0.96 (0.87–1.07)	.485	1.01 (0.91–1.11)	.860
Unauthorized distribution of sensitive material (ref. never)						
Daily	1.72 (0.72–4.10)	.212	0.72 (0.62–0.84)	**<.001**	1.04 (0.89–1.21)	.654
Weekly	1.53 (0.99–2.37)	.055	0.84 (0.76–0.93)	**<.001**	0.97 (0.89–1.07)	.578
Monthly	1.25 (0.86–1.81)	.245	0.95 (0.87–1.04)	.248	1.03 (0.94–1.12)	.537
Phishing attempts (ref. never)						
Daily	1.92 (0.82–4.54)	.134	0.75 (0.64–0.88)	**<.001**	0.86 (0.72–1.01)	.062
Weekly	1.15 (0.69–1.89)	.598	0.82 (0.73–0.91)	**<.001**	0.93 (0.83–1.05)	.246
Monthly	1.13 (0.73–1.75)	.579	0.98 (0.90–1.08)	.738	0.96 (0.87–1.05)	.318
Misinformation (ref. never)						
Daily	2.24 (1.25–4.03)	**.007**	0.93 (0.80–1.07)	.298	0.91 (0.78–1.05)	.195
Weekly	1.48 (0.93–2.34)	.099	0.96 (0.86–1.07)	.475	0.93 (0.83–1.04)	.203
Monthly	1.18 (0.71–1.98)	.525	1.07 (0.94–1.21)	.318	0.94 (0.83–1.06)	.304
Sale or distribution of drugs (ref. never)						
Daily	1.85 (1.03–3.35)	**.041**	0.68 (0.59–0.78)	**<.001**	1.19 (1.05–1.36)	**.009**
Weekly	1.57 (0.95–2.58)	.076	0.79 (0.72–0.87)	**<.001**	1.05 (0.95–1.16)	.331
Monthly	1.07 (0.66–1.72)	.796	0.85 (0.76–0.96)	**.006**	1.11 (0.99–1.23)	.071
Harmful social media challenges (ref. never)						
Daily	1.51 (0.61–3.77)	.359	0.65 (0.55–0.75)	**<.001**	1.13 (0.97–1.32)	.111
Weekly	1.34 (0.87–2.06)	.180	0.87 (0.79–0.95)	**.003**	0.98 (0.89–1.07)	.596
Monthly	1.76 (1.21–2.57)	**.003**	0.95 (0.87–1.04)	.293	0.97 (0.89–1.06)	.479
Content causing appearance pressures (ref. never)						
Daily	1.81 (1.00–3.29)	**.050**	0.63 (0.55–0.71)	**<.001**	1.00 (0.89–1.13)	.997
Weekly	1.67 (1.05–2.65)	**.029**	0.79 (0.71–0.88)	**<.001**	0.94 (0.85–1.04)	.236
Monthly	2.63 (1.66–4.18)	**<.001**	0.86 (0.76–0.97)	**.014**	0.95 (0.85–1.06)	.312

Note. Fixed-effects multinomial logistic regression models: odds ratios (OR); 95% confidence intervals (CI); ref. = reference category. Regression models for each social media threat were run separately. Social media threats were treated as outcome variables in the models (see Figure 1) and are represented on the table rows instead of the columns due to space constraints. The models were adjusted for age, gender, family affluence, family support, friend support, problematic social media use, and online communication with strangers.

6.2 Digital media use and health

6.2.1 Patterns of digital media use and health (Study I, II)

The various patterns of digital media use were associated with health outcomes among adolescents. As regards the internet user profiles, descriptive analyses and regression analyses showed that friendship-driven, excessive, and interest-driven users were more likely to report frequent depressive feelings compared to abstinent users (Table 7). Friendship-driven and excessive users were also more likely to report frequent depressive feelings compared to irregular users. Furthermore, friendship-driven, excessive, and interest-driven users were more likely to report frequent morning tiredness compared to irregular users. Friendship-driven and excessive users were also more likely to report morning tiredness compared to abstinent users (see the confidence intervals in Study I). There were no significant differences in self-rated health between the user profiles.

TABLE 7 The associations of internet user profiles with health outcomes.

Measure		**Self-rated health**		**Depressive feelings**		**Morning tiredness**	
	All	Good	Poor	Not frequently	Frequently	Not frequently	Frequently
	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Friendship-driven users	36.4	86.2	13.8	61.2	38.8	66.3	33.7
Irregular users	25.0	86.4	13.6	72.3	27.7	75.5	24.5
Abstinent users	18.0	86.4	13.6	75.6	24.4	74.0	26.0
Excessive users	11.1	81.0	19.0	53.8	46.2	63.2	36.8
Interest-driven users	9.5	84.4	15.6	64.2	35.8	66.6	33.4

Note. P-values: Self-rated health: .123, Depressive feelings: **<.001**, Morning tiredness: **<.001**

In terms of PSMU, based on the generalized linear models and random-effects meta-analytic pooling, problematic users were more likely to report poorer self-rated health, lower life-satisfaction, and more frequent sleep difficulties in Finland (Table 8). Furthermore, similar relationships were consistent in five other countries, and cross-nationally. The tables for the associations between PSMU and health outcomes in five European countries and cross-nationally are included in Study II.

TABLE 8 The associations of problematic social media use (PSMU) with health outcomes among Finnish adolescents.

Measure	**Self-rated health (continuous)**			**Life satisfaction (continuous)**			**Sleep difficulty (continuous)**		
	B	SE	*p*-value	B	SE	*p*-value	B	SE	*p*-value
PSMU	-0.238	0.048	**<.001**	-0.598	0.121	**<.001**	-0.647	0.091	**<.001**

Note. Generalized linear models; Beta coefficients (B), Standard error (SE). Sleep difficulty outcome was inverted to correspond to other health outcomes. The models were adjusted for gender, age, and family affluence.

6.2.2 Social media threats and health (Study IV)

Adolescents who were exposed to any social media threats on a daily or weekly basis were more prone to poor self-rated health, frequent depressive feelings, and frequent anxiety symptoms, compared to those who never reported exposure to social media threats (Table 9). Moreover, adolescents who experienced any of the threats as seldom as once a month were more likely to report frequent depressive feelings than were those who never encountered social media threats. Similarly, adolescents who were exposed to one out of eight threats monthly were more likely to report frequent anxiety symptoms than those reporting none, misinformation being the only exception. Adolescents who were exposed monthly to cyberbullying, sexual harassment, or phishing attempts were more likely to report poor self-rated health than those reporting none.

TABLE 9 The association of social media threats with health outcomes.

Measure	**Self-rated health (ref. good self-rated health)**		**Depressive feelings (ref. no frequent depressive feelings)**		**Anxiety (ref. no frequent anxiety)**	
	OR (CI 95%)	*p*-value	OR (CI 95%)	*p*-value	OR (CI 95%)	*p*-value
Cyberbullying (ref. never)						
Daily	2.55 (1.31–4.97)	**.006**	3.15 (1.69–5.85)	**<.001**	2.99 (1.59–5.61)	**<.001**
Weekly	3.20 (1.97–5.21)	**<.001**	2.75 (1.67–4.53)	**<.001**	3.63 (2.37–5.54)	**<.001**
Monthly	1.97 (1.35–2.88)	**<.001**	2.48 (1.79–3.43)	**<.001**	2.60 (1.84–3.66)	**<.001**
Sexual harassment (ref. never)						
Daily	3.14 (1.50–6.61)	**.004**	4.08 (2.16–7.71)	**<.001**	3.62 (2.05–6.41)	**<.001**
Weekly	3.37 (2.24–5.08)	**<.001**	2.49 (1.66–3.73)	**<.001**	3.07 (2.10–4.50)	**<.001**
Monthly	1.54 (1.06–2.24)	**.023**	2.22 (1.64–3.01)	**<.001**	2.34 (1.70–3.23)	**<.001**
Racism (ref. never)						
Daily	2.53 (1.57–4.09)	**<.001**	4.42 (2.66–7.33)	**<.001**	3.47 (2.26–5.34)	**<.001**
Weekly	1.98 (1.41–2.79)	**<.001**	2.87 (2.13–3.86)	**<.001**	2.99 (2.27–3.94)	**<.001**
Monthly	1.01 (0.70–1.45)	.977	1.47 (1.10–1.97)	**.010**	1.62 (1.25–2.11)	**<.001**
Unauthorized distribution (ref. never)						
Daily	3.32 (1.97–5.59)	**<.001**	3.51 (2.16–5.72)	**<.001**	3.12 (1.94–5.04)	**<.001**
Weekly	2.38 (1.71–3.32)	**<.001**	2.19 (1.62–2.97)	**<.001**	3.57 (2.59–4.92)	**<.001**
Monthly	1.35 (0.96–1.91)	.084	1.53 (1.13–2.09)	**.007**	1.65 (1.25–2.18)	**<.001**
Phishing attempts (ref. never)						
Daily	3.81 (2.10–6.88)	**<.001**	3.37 (1.99–5.72)	**<.001**	4.34 (2.62–7.18)	**<.001**
Weekly	3.06 (2.10–4.46)	**<.001**	2.61 (1.85–3.69)	**<.001**	3.04 (2.18–4.24)	**<.001**
Monthly	1.89 (1.34–2.67)	**<.001**	1.33 (1.01–1.75)	**.044**	1.73 (1.30–2.30)	**<.001**
Misinformation (ref. never)						
Daily	2.83 (1.68–4.76)	**<.001**	4.15 (2.63–6.54)	**<.001**	3.78 (2.47–5.78)	**<.001**
Weekly	1.93 (1.22–3.05)	**.005**	2.53 (1.73–3.69)	**<.001**	2.72 (1.97–3.74)	**<.001**
Monthly	1.43 (0.87–2.36)	.159	1.54 (1.02–2.31)	**.040**	1.33 (0.93–1.90)	.121
Sale or distribution of drugs (ref. never)						
Daily	2.02 (1.26–3.24)	**.004**	3.20 (2.17–4.73)	**<.001**	3.94 (2.72–5.70)	**<.001**
Weekly	1.80 (1.26–2.58)	**.001**	1.86 (1.38–2.52)	**<.001**	2.75 (2.06–3.67)	**<.001**
Monthly	1.16 (0.77–1.75)	.479	1.43 (1.02–1.99)	**.038**	1.62 (1.17–2.24)	**.004**
Harmful social media challenges (ref. never)						
Daily	2.13 (1.24–3.66)	**.007**	4.18 (2.56–6.84)	**<.001**	4.58 (2.70–7.77)	**<.001**
Weekly	1.65 (1.13–2.42)	**.011**	2.42 (1.80–3.26)	**<.001**	2.81 (2.09–3.76)	**<.001**
Monthly	1.11 (0.80–1.55)	.524	1.59 (1.18–2.13)	**.002**	1.80 (1.39–2.34)	**<.001**
Content that causes appearance pressures (ref. never)						
Daily	5.12 (3.39–7.74)	**<.001**	8.89 (6.21–12.73)	**<.001**	6.96 (4.85–9.97)	**<.001**
Weekly	2.14 (1.48–3.10)	**<.001**	3.32 (2.46–4.48)	**<.001**	4.94 (3.72–6.55)	**<.001**
Monthly	0.98 (0.61–1.57)	.925	1.65 (1.17–2.33)	**.004**	2.02 (1.50–2.73)	**<.001**

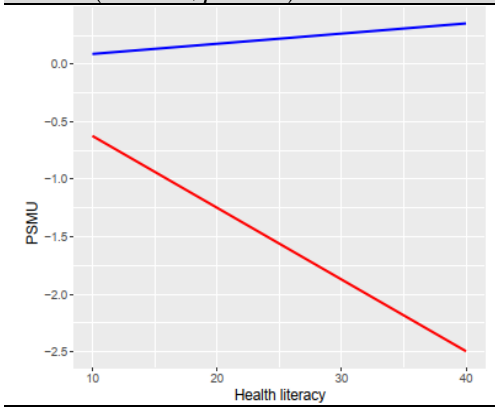
Note. Fixed-effects binary logistic regression models: odds ratios (OR); 95% confidence intervals (CI); ref. = reference category. Regression models for each social media threat were run separately. Health outcomes were treated as outcome variables in the models (see Figure 1). The models were adjusted for gender, age, and family affluence.

6.3 Digital media use and moderating processes

6.3.1 Moderations of individual and social resources between individual and social factors and problematic social media use (Study II)

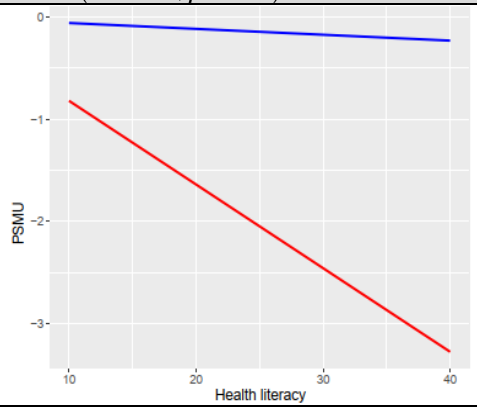
Stratified models were performed to assess the moderation of health literacy, family support, and friend support between individual and social factors and PSMU. The assessments were conducted for Finland, five European countries, and cross-nationally. In Finland, a higher level of health literacy was associated with a lower likelihood of PSMU among girls and adolescents experiencing frequent depressive feelings (Figure 3). It was also observed in Finland that higher levels of family and friend support were linked to a reduced probability of PSMU among adolescents from less affluent families. Similar moderations were not observed in other countries. However, in Belgium, a higher level of family support was linked to a greater likelihood of PSMU among adolescents with frequent depressive feelings, but to a lower likelihood among those without frequent depressive feelings. Cross-nationally, it was observed that higher family support was associated with a reduced likelihood of PSMU; this was more the case among adolescents without frequent depressive feelings than among those with frequent depressive feelings; nevertheless, it was related to a reduced likelihood of PSMU in both groups. Study II includes detailed tables (showing significant and non-significant interactions) and figures for the moderations, in five other European countries and cross-nationally.

A) Gender*health literacy
(B = -0.071, ***p* = 0.003**)



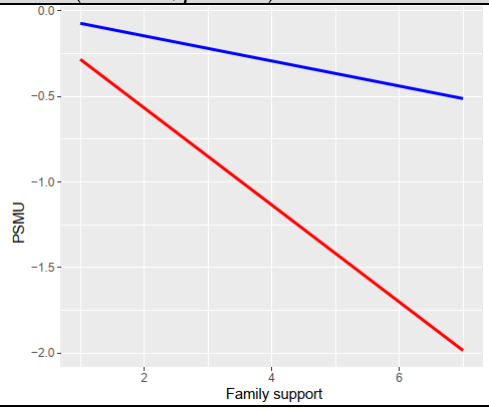
– Boy (B = 0.009)
– Girl (B = -0.062)

B) Depressive feelings*health literacy
(B = -0.076, ***p* = 0.003**)



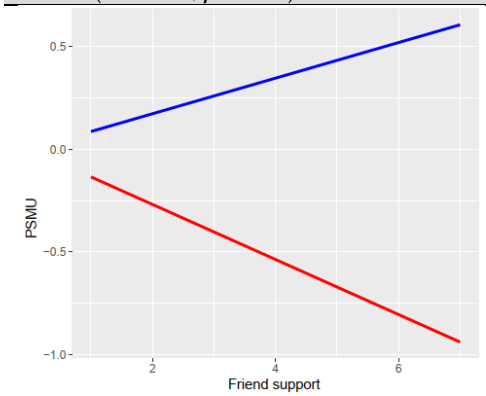
– No frequent depressive feelings (B = -0.006)
– Frequent depressive feelings (B = -0.082)

C) Family affluence*family support
(B = -0.210, ***p* = 0.029**)



– High family affluence (B = -0.073)
– Low family affluence (B = -0.283)

D) Family affluence*friend support
(B = -0.221, ***p* = 0.031**)



– High family affluence (B = 0.087)
– Low family affluence (B = -0.134)

FIGURE 3 The significant moderations between individual and social factors and problematic social media use (PSMU) in Finland.

6.3.2 Moderations of individual and social resources between problematic social media use and health outcomes (Study II)

The moderating role of health literacy, family support, and friend support between PSMU and health outcomes was inspected in Finland, in five European countries, and cross-nationally. No significant moderations were observed in Finland. However, in the Czech Republic, higher health literacy was more strongly related to higher self-rated health among nonproblematic than problematic users. In Poland, higher health literacy was linked to higher life satisfaction among both problematic users and nonproblematic users; however, the association was stronger among problematic users. In Germany, having a higher level of health literacy was more strongly related with having fewer sleep difficulties among problematic users than among nonproblematic users.

In Estonia, higher family support was associated with higher self-rated health among both problematic and nonproblematic users, but the association was stronger among problematic users. By contrast, as regards having fewer sleep difficulties, the relationship with higher family support was stronger among nonproblematic users. In Estonia and Germany, higher family support was linked to higher life satisfaction among both problematic and nonproblematic users, but the association was stronger among problematic users than among nonproblematic users.

In Estonia, higher friend support was more strongly associated with higher life satisfaction among problematic users than among nonproblematic users. By contrast, in the Czech Republic, higher friend support was associated with lower life satisfaction among problematic users, but with higher life satisfaction among nonproblematic users.

Cross-nationally, higher health literacy was associated more strongly with higher life satisfaction, and higher family support more strongly with higher self-rated health among problematic users than among nonproblematic users. Study II includes detailed tables (showing significant and non-significant interactions) and figures for the moderations in five other European countries, and cross-nationally.

7 DISCUSSION

7.1 Discussion on the main findings and their key messages

The purpose of the research conducted for this thesis was to comprehensively examine Finnish adolescents' digital media use. Specifically, the aims were to examine 1) adolescents' patterns of digital media use, social media threats, and their relation to individual and social factors, 2) the association between patterns of use, social media threats, and health outcomes, and 3) the moderating role of individual and social resources between these associations. The additional aims were to monitor the changes in problematic social media use between 2018 and 2022 in Finland, and to compare problematic social media use, associated factors, health outcomes, and moderating processes between Finnish adolescents and their counterparts in five European countries. These aims were initially addressed in four original research articles (Studies I–IV). The thesis summarizes, builds on, and extends the insights provided by these articles, thus going beyond what was covered in each individual study. In the following sections, I shall discuss the findings detailed in this thesis in the order of the main empirical research questions, and briefly summarize their scientific contributions and key messages. Thereafter, I shall discuss the strengths and limitations, as well as methodological and ethical considerations. I shall conclude by outlining the societal implications, future directions for research, and final remarks and suggestions.

7.1.1 Adolescent digital media use is a complex phenomenon explained by individual and social factors

Consistent with prior studies on the topic, adolescent digital media use was found to be fundamentally complex and multidimensional (Eynon & Malmberg, 2011; Hietajärvi, 2019; Hietajärvi et al., 2019; Maksniemi, 2023). Despite this, the first key discovery of this study was that the diverse range of digital activities among young people can be explained via person-oriented internet user profiles,

classified as friendship-driven users, interest-driven users, excessive users, irregular users, and abstinent users. The structure of the internet user profiles among adolescents reflected the user categories found in previous studies (Brandtzaeg et al., 2010; Eynon & Malmberg, 2011; Hietajärvi et al., 2019; Ito et al., 2010; Maksniemi, 2023). Out of all the forms of digital activity, adolescents appeared to be most attuned to friendship-driven use, being primarily directed by socially-oriented activities. This finding is strongly in line with existing literature (Hietajärvi et al., 2019; Lyyra et al., 2022; Maksniemi 2023), and matches with the self-described motives of adolescents in using the digital media, which include primarily the need for social connection (Romero Saletti et al., 2022; van der War et al., 2022). From a developmental perspective, adolescence represents a crucial period for social interaction and the building of social relations (Backes et al., 2019; Granic et al., 2020; Orben et al., 2020). Friendship-driven digital practices can facilitate these developmental tasks by making adolescents feel more connected with their friends, and by allowing young people to access social support during tough times (Anderson & Jiang, 2018). Research examining adolescent social behaviour indicates that when communicating online, the key aspects and attributes of face-to-face interactions – which include information disclosure, interactivity, social reward, and social support – remain prevalent (Orben et al., 2020), and this could explain the popularity of friendship-driven use among adolescents. Friendship-driven users showed a likelihood of being 15-year-old, girls; they demonstrated relatively favourable background factors such as high health literacy and friend support, as has been found in previous research (health literacy, see Lyyra et al., 2022; friend support, see Anderson & Jiang, 2018; Bouchillon, 2020; Smahel et al., 2020).

Excessive users were characterized by their intensive participation in a wide range of digital activities, with the notable exception of more complex media-related activities and blogging. In contrast with earlier studies (Brandtzæg et al., 2010), where the most frequent users often also engaged in more sophisticated and technically-demanding online activities, the excessive user group in this study showed a lesser inclination towards such complex activities. Nevertheless, excessive users were the most active user profile in terms of getting to know new people and searching for like-minded friends online. In contrast, interest-driven users emerged as a user profile characterized by a greater inclination towards activities that are both complex and media-oriented. Hence, interest-driven users came closest to resembling the genre identified by Ito et al. (2010) in 'geeking out' or a stereotypical 'digital native' portrayed in the popular media (encompassing those for whom many aspects of digital media are intuitive and ubiquitous elements of daily life; Mertala et al., 2024; Nesi et al., 2022).

Typically, excessive and interest-driven users encompassed older adolescents aged 15. Interest-driven users were more likely to be boys; they tended to have the highest prevalence of certain unfavourable background characteristics such as low academic achievement, low health literacy, and low social support from friends and family. Previous research has indicated that those in vulnerable situations may be drawn to maladaptive patterns of

engagement as a means of escape, and may not find a sense of meaning in offline contexts (which could include academic purposes) (Hietajärvi, 2019; Maksniemi, 2023). While interest-driven use itself may not be inherently maladaptive, it is evident that a certain level of disconnection exists between interest-driven users and their engagement in traditional offline endeavours.

Although public discourse often portrays all adolescents from Generation Z as adept and prolific users of digital media (Mertala et al., 2024; Valkenburg & Piotrowski, 2017), this study highlights the fact that certain adolescents exhibit irregular or abstinent usage patterns, characterized by limited engagement with various digital media activities. Note, however, that within this study, irregular users were more versatile in their use compared to abstinent users, who leaned more towards the 'non-user' profile (Brandtzaeg et al., 2010), except in terms of certain forms of entertainment (notably listening to music and online games), and talking while online. Boys and younger adolescents, particularly those aged 11, tended to exhibit irregular or abstinent usage patterns. These findings may be attributed to younger adolescents having less experience with different media platforms, resulting in less active digital engagement (especially in complex or technologically demanding activities) (Fuller et al., 2023; Hietajäri et al., 2016).

As adolescents get older, they often develop a greater need for social interaction, independence, and identity exploration (Backes et al., 2019; Orben et al., 2020). This increases the allure of digital media and causes a shift towards more active user profiles. The neural, cognitive, and social (developmental) changes leading to this shift in early adolescence occur sooner for girls than for boys, which may partly explain the gender differences observed (Orben & Blakemore, 2023; Orben et al., 2022). It is also notable that many platforms (e.g. TikTok) are not intended for adolescents under the age of 13 (Lahti et al., 2022). Nevertheless, the findings are consistent with previous studies that explain the patterns of adolescent digital media use in terms of the developmental stage (Orben & Blakemore, 2023; Orben et al., 2022). They are also in line with research indicating that participation in various digital activities increases when adolescents transition from early adolescence to middle adolescence (Boer, 2022; Hietajärvi et al., 2019; Orben et al., 2020).

While acknowledging the positive ways in which adolescents engage with digital media (including friendship-driven communication: Lyyra et al., 2022; Orben et al., 2020), this thesis revealed that approximately one in ten Finnish adolescents aged 13 and 15 exhibited problematic social media use, and hence had difficulties in controlling their use; also that they persisted in upholding this behavioural pattern despite negative consequences and relational conflicts (Boer et al., 2021; Boer, van den Eijnden, et al., 2022; van den Eijnden et al., 2016). It has been argued that platforms such as TikTok are designed to make social media more addictive (due to various structural and contextual features, such as short-format, fast-paced videos) (Marengo et al., 2022). Nevertheless, there were no significant changes in PSMU prevalence in Finland between 2018 and 2022. Individual and social factors were found to explain PSMU, as has been proposed by the DSMM (Valkenburg & Peter, 2013) and by earlier literature (Boer et al.,

2020; Boniel-Nissim et al., 2022; L. Paakkari et al., 2021). In the present research, it was notable that Finnish adolescents experiencing depressive feelings were more likely to report PSMU, while those with higher levels of health literacy and stronger family support exhibited lower PSMU rates.

As regards the special aim of investigating how Finnish adolescents' PSMU and associated factors compare internationally, it should be noted that there were variations in PSMU prevalence and in contributing factors in the present study. For instance, girls showed higher levels of problematic use as compared to boys in certain countries, while cross-nationally, friend support was associated with a reduced likelihood of PSMU. Neither of these associations was observed among Finnish adolescents. Country-level variations in PSMU and associated factors may be attributed to the prevailing cultural norms, social regulations, and attitudes towards social media use within each country. These factors can influence the extent to which parents and schools impose restrictions, provide support, and offer education on social media use. Additionally, they can shape the degree to which PSMU is perceived as socially normal and accepted, in line with the principles of normalization theory (cf. Pennay & Measham, 2016).

Another key finding in this research was confirmation of the various social media threats encountered by Finnish adolescents. Of these, direct and indirect cyberbullying and sexual harassment were considered to be the most important by the Delphi expert panel. In general, the main social media threats identified by the panel were in line with previous research investigating the perspectives of experts (Uhls et al., 2017) and adolescents (Smahel et al., 2014). Out of the Finnish adolescents examined in the present study, every fifth had been exposed, at least monthly, to cyberbullying and sexual harassment. At a daily level, the most common social media threats were misinformation, content causing appearance pressures, and content on the sale or distribution of drugs. On a weekly level, the main threats came from misinformation, harmful or dangerous social media challenges, and unauthorized distribution of sensitive material. On closer examination, one can see that the social media threats perceived as most important by the expert panel did not necessarily align with the most prevalent threats encountered by the adolescents. In this regard, it seems reasonable to argue that cyberbullying and sexual harassment create inherently more serious harm than is caused by misinformation. The crucial point is that they specifically target an individual recipient of the message (Barlett & Gentile, 2012; Kowalski et al., 2014), while several other threats (such as misinformation) affect anyone who receives the message (see Zarocostas, 2020). Thus, when assessing social media threats and their severity, it is imperative to consider not only their prevalence but also the potential harm they can inflict on the individuals exposed to them.

Individual and social factors were found to explain adolescent exposure to social media threats. For example, adolescents aged 15 were more likely than those aged 11 to report encounters with all the social media threats under study. A possible explanation for this is that the older adolescents had enhanced participation in various digital activities (as shown in this thesis), including

increased time spent on the internet and social media (Vogels et al., 2022). These aspects increase the probability of encountering social media threats (Staksrud et al., 2013). However, it could also be that the social media provide a novel environment for older adolescents to display their enhanced risk-taking proclivities (Crone & Konijn, 2018; Lewycka et al., 2018), resulting in more frequent encounters with threatening online situations.

The findings of this thesis also showed that boys are more likely than girls to report daily encounters with seven out of the nine social media threats (including cyberbullying, racism, and phishing attempts). Conversely, girls are more likely to encounter content causing appearance pressures on a daily, weekly, and monthly basis – a finding supported by previous literature (Choukas-Bradley, 2022). The possible reasons for this include (i) that girls are more likely than boys to self-objectify and internalize unrealistic appearance standards (Rousseau, 2021; Vandenbosch et al., 2022), (ii) that girls are socialized to value their appearance on social media, (iii) that the social media contain more appearance-oriented material aimed at girls, and (iv) that girls are more sensitive than boys in terms of perceiving content on social media that causes appearance pressures (Rousseau, 2021; Vandenbosch et al., 2022).

Adolescents with higher levels of family affluence were more likely to report misinformation and the sale or distribution of drugs (daily), content causing appearance pressures (daily, weekly, and monthly), and harmful social media challenges (monthly). Some time ago these findings could have been explained via greater access to digital media among those with higher affluence; however, at the present time, almost every adolescent in Finland has access to the internet (Official Statistics of Finland, 2021). It is generally accepted that adolescents from low-affluence families are more prone to engage in risky behaviours and to experience negative health (Napoletano et al., 2016; Odgers, 2015; Poulain et al., 2019); hence, it could be that those from higher socio-economic backgrounds are better equipped to identify and report issues such as misinformation or appearance-oriented content, due to a better understanding of the phenomena and their ensuing negative consequences (Elgar et al., 2016). However, this is only one possible explanation, and more research on the topic is needed.

In addition to the above, it was found that a higher level of emotional intelligence was associated with a lower probability of daily exposure to cyberbullying, sexual harassment, and phishing attempts; also, that family support was associated with a lower probability of daily and weekly encounters with eight of the nine studied social media threats. These findings support the claim that factors such as emotional intelligence and family support operate as resources against social media threats (DeKimbe et al., 2019; Elsaesser et al., 2017; Incardona et al., 2023; Marengo et al., 2020). However, the influence of friend support on social media threats was more multifaceted, and this association differed depending on the type of threat. For instance, a higher level of friend support was positively associated with daily exposure to the sale and distribution of drugs. Conversely, a higher level of friend support had a negative

association with daily exposure to cyberbullying. Existing studies suggest that social media can intensify peer influence, impacting on adolescent behaviour and cognitive processes (Moreno & Whitehill, 2014; Nesi et al., 2018a). Adolescents with higher friend support may thus engage in drug-related behaviour in efforts to bond with deviant peers and elevate their social standing (Vannucci et al., 2020). However, these same friendships that heighten adolescent risk behaviour on social media may also serve as a protective resource against other threats, such as cyberbullying (Nixon et al., 2014).

Scientific contributions and key messages: The thesis progressed beyond digital screen time measures (Griffioen et al., 2020; Nesi et al., 2022; Parry et al., 2021; Valkenburg, 2022) and demonstrated that digital media use can and should be explained via person-oriented internet user profiles, PSMU, and social media threats. It provides a generalizable and comprehensible description of the factors explaining Finnish adolescent digital media use, and it presents previously undiscovered associations (such as a higher level of family support being associated with a lower likelihood of daily, weekly, and monthly exposure to sexual harassment, the sale or distribution of drugs, or content causing appearance pressures). Thus, the thesis sheds light on relevant protective factors, and also on factors that could place adolescents in a vulnerable position (as in the case of adolescents aged 15 reporting a higher likelihood of all social media threats daily and weekly than that reported by 11-year-olds). The study advanced and refined the methodology to study adolescent digital media use via a multimethod design (as in combining person-oriented LCA with regression analyses). It identified key social media threats (via the Delphi method) and developed a relevant scale for their measurement.

The key takeaways are that while various digital activities offer undeniable benefits, and can facilitate key adolescent developmental tasks, many adolescents also use social media problematically and are exposed to a range of threats. Individual and social factors play a paramount role in explaining adolescents' digital media use, and those with more favourable background factors often report more positive ways of using digital media, whereas those in vulnerable situations are probably at a greater risk for PSMU and social media threats (indicating that vulnerabilities offline beget vulnerabilities online).

7.1.2 Patterns of digital media use and social media threats differently explain adolescent health

In line with previous research on the topic, adolescent patterns of digital media use and exposure to social media threats were shown to differently explain a range of health outcomes (Boer et al., 2020; Boniel-Nissim et al., 2022; Lyyra et al., 2022; Maksniemi, 2023; Valkenburg, Meier, et al., 2022). The findings of this thesis showed that the less active user profiles (comprising abstinent or irregular users) were less likely to report negative health outcomes (frequent depressive feelings, morning tiredness) than were more active user profiles. However, one must bear in mind that these less active user profiles mostly represented younger

adolescents, who generally tend to report fewer negative health outcomes such as depressive feelings – a finding that has emerged both in Finland (Ojala & Kulmala, 2023) and cross-nationally (Inchley et al., 2020).

Consistent with the literature (e.g. Boer et al., 2020; Boniel-Nissim et al., 2022, 2023; L. Paakkari et al., 2021), this study found that Finnish adolescents with PSMU reported poorer self-rated health, lower life satisfaction and more frequent sleep difficulties. The findings related to PSMU were consistent across five other European countries. It was further demonstrated that encounters with social media threats, both daily and weekly, systematically explained poor self-rated health, frequent depressive feelings, and frequent anxiety symptoms among Finnish adolescents. Encounters with any of the nine social media threats even as infrequently as once a month heightened the likelihood of experiencing at least one negative health outcome. Furthermore, certain threats, such as cyberbullying and sexual harassment, when encountered once a month, increased the probability of all the examined negative health outcomes. Generally, the odds ratios for negative health outcomes rose with the increasing frequency of exposure to social media threats. For example, exposure to harmful social media challenges monthly raised the likelihood of frequent depressive feelings by 59%, while daily exposure to such challenges raised the likelihood by 318%, in comparison with those who had never been exposed to harmful challenges. These findings support the claim that increased exposure to social media threats contributes to negative health in adolescence (Maghsoudi et al., 2020; Seabrook et al., 2016).

Several mechanisms can explain the associations found between digital media use and health in this thesis. Firstly, it has been proposed that there is a correlation between PSMU and more frequent engagement with various digital media activities, and with more intensive use patterns (Boer et al., 2020; Boniel-Nissim et al., 2022) – a finding that also emerged in Study I. Hence, PSMU may function as a confounder between more frequent participation in digital activity and negative health (Boer et al., 2020, 2021). High levels of participation in digital activities do not necessarily harm adolescent health, insofar as these activities may not intrude on crucial life domains such as socializing with friends and family (Boer et al., 2020, 2021). In other words, adolescents who frequently engage in various activities may still be able to regulate their participation and integrate it with a healthy lifestyle. In contrast, problematic users have lost control over their emotions, thoughts, and behaviours related to social media, leading to social media dominating their daily lives (Andreassen, 2015; Lee et al., 2017; van den Eijnden et al., 2016). This loss of personal agency seems to be detrimental to adolescent health, as demonstrated in this thesis (as in PSMU explaining poorer self-rated health, life satisfaction, and more frequent sleep difficulties).

Secondly, more frequent participation in digital activities naturally increases the chance of encounters with social media threats (Lobe et al., 2021; Ognibene et al., 2023; Staksrud et al., 2013) – threats that were systematically related to negative health outcomes among the adolescents in this thesis.

Considering these aspects, it could be argued that the intensity of digital media use, or belonging to a more active user profile, does not in itself necessarily imply negative health in adolescence; rather, the negative health outcomes related to adolescent digital media use are likely to be due to problematic use patterns, and to harmful, provocative, and dangerous encounters with threatening situations on social media.

The findings of this study should be considered together with the results of earlier research indicating positive links between various digital activities and various wellbeing outcomes such as higher life satisfaction (Lyyra et al., 2022), higher mental wellbeing (Anthony et al., 2023), and higher social wellbeing (K. A. Allen et al., 2014; Angelini et al., 2023; Boniel-Nissim et al., 2022; Orben et al., 2020); also with the notion that digital media use is normative adolescent behaviour, and that exclusion from digital media could have negative implications, especially for older adolescents with increased social needs (including the need to establish and maintain more complex or intimate peer relationships) (Nesi et al., 2018b, 2022; Valkenburg & Piotrowski, 2017). Another point to consider is that the findings of this thesis and earlier studies demonstrate individual and social factors (such as adolescent differential susceptibility) as playing a role in the associations between digital media use and health (Beyens et al., 2024). Hence, while certain use patterns and content encounters can be either harmful or beneficial for some, they are not necessarily so for others. Adolescent digital media use differs from adolescent to adolescent (Beyens et al., 2020), as does its effects on health.

Scientific contributions and key messages: The study represents frontier research, insofar as it is one of the first to undertake a comprehensive, and simultaneous examination of the role of various fine-grained digital media measures that could explain validated adolescent health outcomes (Griffioen et al., 2020; Nesi et al., 2022; Parry et al., 2022; Valkenburg, 2022; Valkenburg, Meier, et al., 2022). It discovered many new associations that could explain frequent depressive feelings and anxiety, including daily and weekly exposure to unauthorized distribution of sensitive material, the sale or distribution of drugs, and harmful social media challenges. Furthermore, the distinct frequency intervals of the social media threats provided new insights into how the frequency of exposure could explain the perceived health outcomes in terms of all the social media threats under study.

Overall, the thesis provides an applicable and broad understanding of the phenomenon, highlighting the role of PSMU and social media threats in explaining negative adolescent health. It further advances an understanding of the methodology applicable to such relationships (by integrating advanced statistical methods such as stratified modelling and random-effects meta-analytic pooling). Consequently, the key message is that PSMU and exposure to various social media threats do indeed appear to operate as mechanisms placing adolescents at risk of negative health outcomes – this despite the fact that the associations between the time spent on the internet and social media and adolescent health have been inconsistent across studies (Valkenburg, Meier, et al.,

2022), and despite the fact that digital media use can be viewed as a normative adolescent behaviour with a positive contribution to health and wellbeing (O'Neil, 2019; Weinstein, 2018; Wenninger et al., 2019).

7.1.3 Resources worked as moderators to counteract problematic social media use and ensuing negative health outcomes

In exploring the moderating processes of individual/social resources, operating between individual/social factors and PSMU, and between PSMU and health outcomes, a key finding (in the Finnish context) was that the resources had the potential to decrease disparities by benefiting adolescents with PSMU-related vulnerabilities. For instance, higher health literacy was associated with benefits for girls (who are more likely to report being at-risk for PSMU in Finland; L. Paakkari et al., 2021) and for those with frequent depressive feelings (Arrivillaga et al., 2022). Furthermore, family and friend support appeared capable of reducing PSMU among adolescents with low family affluence (Lenzi et al., 2022). It is worth noting that while family affluence was not directly associated with PSMU in Finland, low affluence is generally considered an indicator of disparity (Elgar et al., 2016). Statistically significant moderations between PSMU and health outcomes were not observed among Finnish adolescents. However, higher levels of all the resources were associated with positive health outcomes, suggesting that the resources benefit both problematic and nonproblematic users equally.

In efforts to understand how Finnish adolescents compare to their international counterparts, significant moderations were observed at national and cross-national levels between individual/social factors and PSMU, and between PSMU and health outcomes, even if these moderations were not observed in Finland. For instance, cross-national analyses indicated that health literacy and family support hold the potential to narrow the gap in health disparities between problematic and nonproblematic users – here bearing in mind, for instance, that higher family support had a stronger association with higher self-rated health among problematic users than among nonproblematic users.

A closer inspection revealed that in some instances, improvements in resources paradoxically widened the disparities between groups. This 'prevention dilemma' (see Boccia & Ricciardi, 2020) or 'promotion paradox' (see Thiel et al., 2018) could be seen particularly in the cross-national analyses, in which a higher level of family support was more strongly related to a lower likelihood of PSMU among those with no frequent depressive feelings than among those with frequent depressive feelings. Nevertheless, these findings must be considered along with cross-national results indicating positive links between health literacy, family support, and friend support in terms of 1) a lesser likelihood of PSMU, and 2) all health outcomes. Neither the promotion paradox nor the prevention dilemma was observed among Finnish adolescents.

In some cases, the resources were linked to a decrease in health disparities on a cross-national level, but these effects were not consistently found in national

analyses. For example, in the cross-national analyses, higher family support was associated with higher self-rated health, with more pronounced benefits for problematic users than for nonproblematic users. However, in individual countries, only Estonia demonstrated a significant effect in this regard. Similarly, while health literacy reduced health disparities between problematic and nonproblematic users cross-nationally, some national analyses revealed opposing results, as in the Czech Republic, where higher health literacy was more strongly linked to higher self-rated health among nonproblematic users than among problematic users. This leads to the question of whether it is justifiable to allocate resources to regional interventions (with similar interventions across all countries) if the benefits are not evenly distributed.

Scientific contributions and key messages: The study filled a gap in the literature, namely the lack of studies on the resources that can be developed and enhanced through education and intervention in efforts to moderate and possibly counteract problematic social media use (Clark et al., 2020; Kickbusch et al., 2021) and its negative health consequences (Boer et al., 2020; Boniel-Nissim et al., 2022; L. Paakkari et al., 2021). The resources under study showed the potential to decrease disparities in health by benefiting adolescents who have PSMU-related vulnerabilities, and narrowing the gap in health disparities between problematic and nonproblematic users.

The thesis concurrently identifies a prevention dilemma and a promotion paradox. This means that improvements in resources might, at times, further widen the disparities between adolescent groups by disproportionately benefiting those in favourable situations more than those in vulnerable situations. Nevertheless, the key message is that health literacy, family support, and friend support in adolescence have the potential to moderate the associations between individual/social factors and PSMU, and the association between PSMU and health outcomes, bearing in mind that country-level and group-level variations exist.

7.2 Strengths, limitations, and methodological and ethical considerations

The thesis demonstrated considerable *strengths*. As regards the data, the thesis used a large-scale, nationally representative sample of adolescents from Finland and from five European countries. In this case, the data were collected in 2018 via a shared data collection protocol (Inchley et al., 2018). In addition, the study incorporated nationally representative data from Finland gathered in 2022. Together, these data allowed for a representative description of prevalences and correlations, reliable international comparisons, and assessment of where we stand in Finland. The data also gave indications of how, compared to other countries, we have developed in terms of digital media use. The representative

nature of the data supported the generalizability of the results. The 2022 data, which include up-to-date measures of adolescent digital media use, enabled the study to react to current phenomena in social media threats, and to compare the development of adolescent problematic social media use between 2018 and 2022. This is important, as the digital media constitute a rapidly-evolving phenomenon, and surveys do not necessarily capture the core of one particular moment (Parry et al., 2021, 2022).

The use of disaggregated HBSC data facilitated the identification of vulnerabilities. The research also used the national Delphi study data, which included a versatile profile of experts with a deep understanding of the social media threats faced by adolescents in navigating social media, and made it possible to develop a scale to measure the social media threats. Furthermore, the study employed measures validated in national or international settings.

Regarding the analytical approaches, this study employed innovative methods, including random-effects meta-analytic pooling and a person-oriented approach in LCA. Random-effects meta-analytic pooling has not previously been used in a similar study setting; hence the approach was novel and offered new insights into ways in which the phenomenon can be studied. Overall, the selection of analytical methods reported in this thesis was broad, and well-suited for research purposes. The study adopted a comprehensive approach, insofar as it compiled knowledge on adolescent digital media use, related individual and social factors, and health outcomes. Another strength is that the study used a suitable theoretical framework (Valkenburg & Peter, 2013) and was built on a robust evidence base. Overall, the study had multidisciplinary benefits, insofar as it advanced research in a number of fields, including health promotion, media-effects research, and psychology.

Finally, the study had a strong ethical foundation, given that all the stages of the research adhered to the guidelines of the Finnish National Board on Research Integrity (Finnish Advisory Board on Research Integrity, 2012) and followed strict ethically-sustainable principles (encompassing consent from all participants, voluntary participation, and a privacy notice). In following the international protocol (Inchley et al., 2018), the HBSC data from all the countries involved had ethical approval. At the same time, according to the Ethical Committee of the University of Jyväskylä, this was not necessary for the Delphi study, due to the anonymous procedures followed. The dissemination and communication of the findings were guided by key ethical principles (see Chapter 5.4). Furthermore, the research findings were directly utilized to benefit the study population and participants, as will be discussed in Chapter 7.3.1.

It is nevertheless important to acknowledge that the thesis had several *limitations*. First and foremost, the cross-sectional design precludes causal inferences. Researchers might reasonably argue that some of the studied associations (e.g. between digital media use and health) could be bidirectional. For instance, depressive feelings may be caused by PSMU, but adolescents with depressive feelings may also be more likely to use social media problematically (Boer et al., 2021). Moreover, all the measures were based on self-report

instruments, which are susceptible to bias. For instance, Parry et al. (2021) have shown discrepancies between self-reported and logged digital media use.

Another point to note is that the 2018 data may not reflect the current status of adolescents' digital media use, given that change is a central component of the digital media (Nesi et al., 2022). For example, TikTok was not in mainstream use in 2018. Thus, adolescents' specific digital media activities and user profiles may have changed since then. Moreover, the international HBSC data did not share the full list of items, so that only partial comparisons were possible.

Certain other possible limitations should be mentioned. Regarding the analyses and their interpretation, the effect sizes and the explained variance in the outcomes were occasionally negligible, even if statistically significant. This was most evident in the effect sizes and variation changes via moderations. This leaves room to question how far some of the results can be interpreted as practically meaningful. The list of control variables (and moderators) in the analytical models was not exclusive, and other factors may also play a role in the studied relationships. It is also important to consider that the interpretation of relationships (e.g. moderations) can go multiple ways. The interpretation of the relationships (e.g. resources as moderator variables) can significantly influence recommendations for policymaking and intervention. It is also worth noting that although some interactions were statistically significant, most of the tested interactions were not.

The Delphi study was limited by clear methodological guidelines (Löfmark & Mårtensson, 2017) and by cultural and geographical factors, insofar as it only considered the views of Finnish experts. The experts' views were subjective, and another Delphi panel could have come to a different conclusion. The first and second rounds carried the risk of biased interpretations and cut-offs. Note also that caution is needed if one is seeking to generalize the results beyond the study populations (e.g. to non-white and low-income countries).

Certain limitations should be acknowledged regarding the theoretical foundation of this thesis. An adapted version of the DSMM was utilized, i.e. one that may not fully capture the construct and nuances of the original model. Notably, consideration was not given to the proposition involving the cognitive, emotional, and excitative response states mediating the associations between media use and media effects. Furthermore, the original model does not propose moderation between individual and social factors and digital media use. Other research, such as that of Johannes et al. (2022), has underscored the need to consider such moderations, which is why they were examined in this thesis. Whilst the DSMM covers three types of susceptibility, there may be other factors influencing media effects that are not accounted for in the model. Certain factors proposed by the DSMM are more stable across time and situations than others, and this could limit the model's applicability in certain contexts.

Compiling a thesis is a process during which both learning and growth occur. Today, with the knowledge and abilities I now have, I would tackle certain aspects of this process differently. One purpose of this thesis involved a deep examination of the complexity of adolescent digital media use – and indeed, I

sought to address this complexity from a theoretical perspective by adopting a suitable theoretical framework in DSMM (Valkenburg & Peter, 2013). However, the methodological approaches (such as the regression analyses) might not sufficiently capture the nuances in adolescent digital media use. Although I also utilized certain novel and advanced approaches, as of today, I would accompany them with analyses such as structural equation modelling, which would better capture the nuances.

Throughout the dissertation process, my supervisors provided invaluable insights and posed critical questions, prompting me to revisit the data and reassess the relationships therein. Leveraging the opportunities provided by the HBSC data, I would thoroughly examine the intricate relationships between a wider array of digital media variables, individual and social factors, and health outcomes. This would facilitate an even broader understanding of the phenomenon.

7.3 Conclusions

This thesis contributes to an understanding of a significant societal phenomenon, namely adolescent digital media use. Despite the substantial body of literature available, our understanding of the complex and multidimensional nature of adolescent digital media use – specifically whether it benefits or harms adolescent health, and for which adolescent groups – has remained limited. This is the case both within Finland and in the broader empirical context (see 3.4). The findings reported here drew a comprehensive picture of adolescent patterns of use and adolescent exposure to social media threats, along with the associated individual and social factors, health outcomes, and moderating processes. Furthermore, the thesis detailed the changes in adolescent PSMU between 2018 and 2022, and it outlined how Finnish adolescent PSMU and related factors and processes compared, with regard to five European countries and cross-nationally. Below, I shall consider the societal implications of the research reported in this thesis. This will be followed by suggested directions for future research and final remarks and suggestions.

7.3.1 Societal implications

Proceeding from disaggregated data, the thesis sheds light on Finnish adolescent digital media use, the related inequities, and the subsequent health outcomes. It also sets out surveillance benchmarks for periods and countries. The findings highlight the importance of fostering equity and non-discrimination in promoting safe digital media environments for all adolescents, with particular attention to those in vulnerable situations. The societal implications relate to the national contexts raised by the Finnish government and the Finnish National Agency for Education. Within these, there is an emphasis on adolescents' rights to digital safety, digital equity, and the importance of digital media as a vital

element for adolescents' present and future lives (Finnish National Agency for Education, 2023; Lonka et al., 2018; Ministry of Education and Culture, 2023). There are further implications related to the objectives set out by international stakeholders such as the United Nations (United Nations, 2021), European Strategy for a Better Internet for Kids (BIK+) (Niestadt, 2022), and the EU Strategy on the Rights of the Child (European Commission, 2021). Overall, the research has the potential to promote safe and secure digital media, non-discrimination, equitable engagement, and consideration of the best interests of young people, while acknowledging the increasingly crucial role of digital media in adolescent development.

The knowledge provided here has already been used in Finland and in international contexts (e.g. the HBSC network) to inform various stakeholders (including researchers, schools, ministries, non-governmental organizations, parents, and adolescents) and to support safe digital media use via sustainable solutions (including education on resources across population groups). Moreover, within Finland, the insights from this thesis have been incorporated into the health education teacher-training curriculum at university level. The findings have also led to the development of new practices and solutions fostering equitable opportunities for adolescents to participate safely in the internet and social media (see Vuorikari et al., 2016). For example, my supervisors and I, along with various stakeholders (e.g. adolescents, teachers, game developers, non-governmental organisations), have developed a digital pedagogical game called SoMe Detectives and a teachers' manual, both of which address problematic social media use and social media threats, together with adolescents' resources to counteract them (Lahti et al., 2022). They also provide valuable information for stakeholders (e.g. parents and educators) on adolescents' digital media use and related problematic situations. SoMe Detectives and the teachers' manual have been disseminated across Finland, and the SoMe Detectives' game has been disseminated internationally through the HBSC network.

In the future, the information provided by the thesis should be used to inform interventions, policy, and practice across various sectors and stakeholders (government, health promotion, service providers, non-governmental organizations, schools, parents, and adolescents). In the long term, via updated policies and interventions targeted at population needs, the societal implications could extend to improvements in adolescents' resources, thus creating better and more equitable opportunities for safe digital media use.

7.3.2 Future directions for research

This thesis opens avenues for future research. Future studies should utilize objective and log-based measures to gain a more nuanced understanding of adolescent digital media use (including digital media activities, problematic social media use, and social media threats) and related individual and social factors and health outcomes. Longitudinal and experimental studies are needed to confirm the causal direction of the effects investigated in this study. Future

studies with longitudinal settings should utilize advanced statistical methodology such as dynamic structural equation modelling. Novel techniques such as n=1 time-series analyses would also be valuable. Group-level investigations in the future should test sophisticated moderation and mediation approaches for population-level effects, for instance, via structural equation modelling.

Person-oriented approaches could be applied to adolescent social media threats to identify around whom social media threats cluster, and the kinds of threats that apply. Furthermore, there is a need for person-specific research (possibly involving a causal effect heterogeneity paradigm; Valkenburg, 2022) on why, for whom, and involving what kinds of digital media, one can anticipate certain negative and positive health outcomes. For example, it is crucial to acknowledge the developmental factors that shape adolescent experiences with digital media (encompassing windows of developmental sensitivity to digital media beyond age as a proxy; Orben & Blakemore, 2023; Orben et al., 2022). Accordingly, we need a more nuanced understanding of the purposes and motivations of different types of engagement with digital media, given that only a few studies have touched on this subject (e.g. Romero Saletti et al., 2022; van der Wal et al., 2022). Future research should test and evaluate the effectiveness of interventions aimed at applying the identified resources.

7.3.3 Final remarks and suggestions

While news headlines often paint young people's digital media use in a negative light, focusing on extreme incidents (Valkenburg & Pitrowski, 2017), this thesis, backed by substantial evidence, reveals that the majority of adolescents engage with digital media in ways that positively impact on various aspects of their wellbeing. Friendship-driven use, such as sharing experiences and communicating with friends online, fosters social self-identity and strengthens peer affiliations (Orben et al., 2020). Moreover, the integration of digital technologies and platforms within all aspects of life offers numerous opportunities for adolescent agency, resilience, learning, competence, education, skills development, employability, participation in civic and democratic processes, and utilization of technologically-enabled health systems for self-management of health (Holly et al., 2023; Kickbusch et al., 2021). Collectively, these opportunities underscore the significance of digital media as a vital context for adolescent growth, development, and wellbeing, both currently and in the future (Boer, 2022; Nesi et al., 2022).

Simultaneously, however, a substantial proportion of adolescents exhibit addiction-like tendencies and encounter threatening situations. Both phenomena are harmful to their health. The distribution of such problems is not equally distributed among young people, and the disparities in digital media seem to reflect inequities in the offline world. Those in higher positions flourish, and they score better on developmental measures. These are the people who sit at the better end of the digital transformation. Conversely, adolescents' offline social deficits translate into online spaces, and those subjected to offline victimization

are also involved in aggressive relationships online. Furthermore, this thesis, and recent findings from the Programme for International Student Assessment (PISA, 2022) and the EU Kids Online survey (2020), highlight a significant societal issue regarding the unequal distribution of resources necessary to navigate digital media safely. The polarization and weakening of skills in the digital context are cumulative; various factors, when accumulated, intensify and sustain social inequity.

Therefore, in relation to the context of this thesis, I would call for universal and targeted interventions, health promotion efforts, and policy practices to reduce adolescents' problematic social media use and exposure to social media threats, and the subsequent negative health consequences. These efforts should ensure that the impact of the resources is proportionately greater among adolescents in vulnerable situations, the aim being to reduce unjust and preventable inequities and health disparities. In doing so, these efforts will adopt an equity lens rather than an equality lens (see proportionate universalism, Marmot et al., 2010). I also suggest that governments and service providers should act and collaborate to reduce problematic social media use and exposure to social media threats. By applying adequate resources, algorithmic strategies, and caregiving interventions, there would be good possibilities to mitigate PSMU, social media threats, and their negative health outcomes (Verma et al., 2022). Additionally, use could be made of advanced technologies, including artificial intelligence, natural language processing, and data mining, since these could aid in identifying and removing online content that is provocative, harmful, and lacking in scientific validity. Parents and educators should be encouraged to support and educate adolescents on when and how to engage with digital media, and they should be there for adolescents in their time of need. By empowering adolescents to develop mindful, responsible, and safe digital habits, we can maximize the benefits, while minimizing the potential drawbacks associated with these technologies.

To conclude, we – as adults – can play a pivotal role in promoting a healthy and balanced relationship between adolescents and their digital media use, and equip them with the necessary skills to thrive in the digital age. Much work is needed to further the aim that no children should be left behind in the digital age, and especially not those who are already disadvantaged in other ways.

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ORIGINAL PAPERS

I

PROFILES OF INTERNET USE AND HEALTH IN ADOLESCENCE: A PERSON-ORIENTED APPROACH

by

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Article

Profiles of Internet Use and Health in Adolescence: A Person-Oriented Approach

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Abstract: (1) Background: Internet use has become an integral part of adolescents' daily lives. It is important to understand how adolescents use the internet, and how this use is associated with demographic factors and health from a person-oriented perspective. (2) Methods: The study applied the Finnish nationally representative HBSC data (persons aged 11, 13, and 15, n = 3408), descriptive observation, latent class analysis, and multinomial logistic regression analysis. (3) Results: Entertainment activities (listening to music) and socially oriented activities (liking posts, talking online) were the most prevalent among adolescents, but gender differences emerged. Five different internet user profiles were identified (encompassing interest-driven, friendship-driven, abstinent, irregular, and excessive users). Interest-driven users participated in interest- and media-oriented activities. Adolescents in the interest-driven user group were more likely to be boys and participants with low academic achievement, high parental monitoring, and high problematic social media use. Friendship-driven users participated in socially oriented activities. Adolescents in the friendship-driven user group were more likely to be girls and participants aged 13 or 15, with high peer and family support. Abstinent users participated only in entertainment, while irregular users showed no particularly high involvement in any internet activity. Adolescents in the abstinent and irregular user groups were likely to be boys and participants aged 11 with high family support. Excessive users had high involvement in internet activities overall. Adolescents in the excessive user group were more likely to be participants with high problematic social media use and were most likely to feel low and tired on school mornings. (4) Conclusion: The study confirmed the prevalence of internet use. It identified five internet user profiles and differences between user profiles regarding individual and social factors and health outcomes.

Keywords: internet; internet use; adolescent; health

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1. Introduction

Internet use has increased enormously in recent decades, leading society into the digital era. Today's adolescents, Generation Z, are the first generation with widespread access to the internet at an early age, and they have an unprecedented amount of technology in their upbringing [1]. Hence, Generation Z has been described as the "net generation" [2]. Since internet use has become a significant part of adolescent everyday life, there are significant questions concerning how adolescents' internet use is associated with individual and social factors, and with possible health implications [3]. So far, most studies have approached adolescents' internet use by seeking to establish general relationships. In contrast, this study adopted a person-oriented approach. In so doing, it aimed to go beyond mere consideration of the average experiences of adolescents and to explore "the interindividual variability and complexity that is a hallmark of human growth" [4].

There is a growing consensus that internet use is a complex and multidimensional phenomenon. Recent review studies have concluded that the effects of internet use on adolescent health depend on various factors, notably including the type of use. In previous

research, different types of internet users have been identified through patterns of participation in different kinds of internet activities, with the patterns being labeled as "genres" [5], "typologies" [6], and "profiles" [7]. In a year-long ethnographic investigation performed on adolescents aged 12–19, Ito et al. [5] identified three "genres" of internet use, namely (i) friendship-driven "hanging out" (motivated by the desire to maintain connections with friends), (ii) interest-driven "messing around" (motivated by fortuitous searching and experimental play), and (iii) creatively oriented "geeking out" (intensive commitment to and engagement with technology, often involving one particular medium, genre, or type of technology *or* creative production *or* gaming). In a meta-analysis, Brandtzæg [6] identified eight "typologies" of internet use. The typologies differed according to frequency of use, variety of use, activities participated in, and platforms used; the user types were divided into non-users (no internet use), sporadics (low internet use, oriented towards no particular activity), debaters (medium internet use, oriented towards blogs and social networks), entertainment users (medium internet use, oriented towards new media and video games), socializers (medium internet use, oriented towards social networks), lurkers (medium internet use, oriented towards social networks and new media), instrumental users (medium internet use, oriented towards shopping online), and advanced users (intensive internet use, oriented towards all activities). In further research, conducted on Finnish adolescents from elementary, secondary, and high school, Hietajärvi et al. [7] identified six "participation profiles", consisting of social-networking-oriented participation (oriented towards communicating with friends), knowledge-oriented participation (oriented towards sharing and gaining information related to one's interests), media-oriented participation (oriented towards to the long term and to complex activities such as creating and sharing videos, pictures, and music), action gamers (oriented towards first-person shooter games, role-playing games, and adventure games), social gamers (oriented towards playing games with social motives such as fun and exercise) and (among high school students), separate blogging-oriented participators (oriented towards activities relating explicitly to blogging).

In addition to the type of use, studies suggest that internet use and its effect on adolescents' health is driven by individual-level factors such as gender, age [8], family affluence [9], and fear of missing out [10]. Also important are friend-level factors (peer support) [11] and family-level factors (parental surveillance) [9,12], in addition to contextual factors (notably a culture of surveillance and comparison) [13]. Overall, longitudinal research has suggested that the effects of the internet differ from adolescent to adolescent [3].

Previous studies have identified both benefits and drawbacks regarding adolescents' internet use, and there has been no clear consensus. On one hand, internet use has been associated with benefits such as new and profound means of self-exploration, self-reflection [14], increased social capital [15], social support and opportunities for finding friends [16], learning and creativity [17], access to information [18], and promotion of self-esteem, social competence, and empathy [19]. On the other hand, meta-analytic studies have highlighted associations between internet use (especially excessive and problematic use) and negative health outcomes in adolescence, including psychosomatic complaints (such as depressive symptoms and anxiety) [20–22] and lower sleep quality [23,24].

Despite the recent increase in research on adolescent internet use, gaps remain, which could be filled by approaches addressing the multidimensional, interindividual complexity of adolescents' internet use. In addition, it is important to study internet use and its relation to individual factors, social factors, and health outcomes via a person-oriented approach, applied to a nationally representative sample. In employing such a person-oriented approach, this study is one of the few to tap into the subject from a multidimensional, interindividual standpoint, going beyond purely aggregate experiences [4]. The research questions for the study were:

- What is the prevalence of different internet activities among adolescents, and are there differences in terms of gender? (RQ1)
- What kind of internet user profiles can be identified, and how are they different in terms of participation in internet activities? (RQ2)

- How are various individual factors (gender, age, family affluence, health literacy, academic achievement) and social factors (friend support, family support, parental monitoring) associated with internet user profiles? (RQ3)
- How are health outcomes (self-rated health, feeling low, morning tiredness) and problematic social media use associated with internet user profiles? (RQ4)

2. Materials and Methods

2.1. Design and Participants

The data used in this study were collected as part of a cross-national collaborative study called Health Behavior in School-Aged Children (HBSC). The present study involved 3408 Finnish adolescents aged 11 years (n = 993), 13 years (n = 1246), and 15 years, n = 1169). The sample included boys (n = 1706) and girls (n = 1702). The schools were chosen using a cluster sampling method aimed at overall reliability, bearing in mind that the schools should be nationally representative in terms of size and the municipalities in which they were located. The participants were asked to fill in a self-completed questionnaire. Administration took place within the classroom. The data collection followed guidelines on the responsible conduct of research according to the protocol of the international HBSC study [25].

2.2. Measures

Self-reported gender and age were measured by asking adolescents to select the correct alternative.

Internet activity was measured via 16 items on how often adolescents participated in the following internet activities [26]: read or look at content (browse), "dig" or "give thumbs up" to other people's postings (like), listen to music (listen), read or look at what acquaintances are doing (follow), write a blog or other text (blog), look for information (info), comment on interesting things (comment), share different content (share), tell acquaintances what I am doing (post), take or edit pictures (picture), play games (game), get to know new people (know people), look for like-minded company (company), take or edit videos (video), make or edit music (music), and talk on the internet (e.g., via WhatsApp or Skype) (talk). The questionnaire employed a Likert-type scale ranging from 1 to 6 (1 = never, 2 = less than once a week, 3 = once a week, 4 = several days a week, 5 = every day once a day, and 6 = several times every day).

The Family Affluence Scale III [27] was used to measure self-reported socioeconomic position. FAS III includes six items: number of family computers, number of family bathrooms, ownership of a car, ownership of a dishwasher, having one's own bedroom, and number of family vacations during the past 12 months. The computed scores were recoded into three categories to indicate relative family affluence: low family affluence (lowest 20%), medium family affluence (middle 60%), and high family affluence (highest 20%), according to the HBSC protocol [25]. *Parental monitoring* was measured via a six-item four-point scale covering adolescents' perceptions of parental monitoring and awareness [28] regarding where they go after school, free-time activity, going out at night, internet activity, spending money, and friends. Scores covering monitoring by both mother and father were computed to form a sum score that was then recoded into three categories: low parental monitoring (lowest 33.3%), medium parental monitoring (middle 33.3%), and high parental monitoring (highest 33.3%).

Health literacy was measured using the Health Literacy for School-Aged Children (HLSAC) instrument [29,30]. The scale consists of ten items that assess the knowledge and competencies that promote health among adolescents. The responses were totaled to produce a sum score, which was then categorized into one of three groups: low health literacy (values 10–25), medium health literacy (values 26–35), and high health literacy (values 36–40). [31].

Academic achievement was measured by asking students to indicate their most recent marks on first language and mathematics. The responses ranged from 4 (fail) to 10 (ex-

cellent). The mean value for both marks was calculated and recoded into one of three categories: low academic achievement (4–7), medium academic achievement (7.5–8.5), and high academic achievement (9–10) [32].

Peer support [33] was measured via a multidimensional scale consisting of four items covering friends' help, being able to count on friends, emotional support, and talking about problems with friends. The scale ranged from 1 = very strongly disagree to 7 = very strongly agree. The score was calculated by adding the items together and dividing them by four. Computed scores were recoded to low peer support (1–2.9), medium peer support (3–5), and high peer support (5.1–7). *Family support* [33] was measured via a multidimensional scale consisting of four items: family help, emotional support, talking about problems with family, and family's willingness to help in making decisions. The scale ranged from 1 = very strongly disagree to 7 = very strongly agree. The score was calculated by adding the items together and dividing them by four. Computed scores were recoded to low family support (1–2.9), medium family support (3–5), and high family support (5.1–7).

Self-rated health (SRH) was measured by a single question on the individual's perception and evaluation of his or her health [34], and the response options were poor, fair, good, and excellent. Response options fair and poor were combined to indicate low SRH, with good and excellent indicating high SRH. *Feeling low* was measured via a HBSC symptom checklist (HBSC-SCL) [35]. Respondents evaluated the frequency of their feeling low over the last six months. Feeling low weekly or more often was categorized as feeling low frequently.

Morning tiredness was measured with a single item: "How often do you feel tired when you get up on school mornings?" [36]. The response categories were rarely or never, sometimes, 1–3 times a week, and 4 or more times a week. Being tired four or more times a week was categorized as a risk for adolescent health.

Problematic social media use (PSMU) was measured via the nine-item Social Media Disorder Scale (SMD-scale) using a dichotomous (No/Yes) answer scale [37]. Based on the values obtained, the respondents were categorized into three groups: a no-risk group, a moderate risk group (at heightened risk of developing problematic use), and a problematic use group. The cut-off value for the problematic use group was 6 or more "yes" answers, for the moderate risk group it was 2–5 "yes" answers, and for the no-risk group it was 0–1 "yes" answers [38].

2.3. Analyses

Descriptive analyses were used to explore the prevalence of internet activities among adolescents. Cross-tabulation, chi-square χ^2-test, and confidence intervals (95% CI) were used to explore the differences in internet activities between boys and girls.

2.4. Mixture Model Selection and Multinomial Logistic Regression

In general, a benefit of mixture models is the variety of fit indices available to examine the best fitting profile solution. However, simulation studies have shown that none of the indices alone can provide a reliable way to detect the proper solution across all combinations of, for instance, model specification, sample size, or possible indicators [39–41]. The model considered here was a latent class analysis (LCA) with categorical indicators, regarding which Nylund, Asparouhov, and Muthén [42] suggest the Bayesian information criterion (BIC) and the bootstrapped likelihood ratio test (BLRT) as the best indicators overall. For models similar to those potentially applicable in the present study, the simulations also indicated that the CAIC and Vuong–Lo–Mendell–Rubin (VLMR) likelihood ratio test would perform well. Yang [43] suggests sample-size-adjusted (N* = (N + 2)/24) BIC (aBIC) to be the overall best-performing indicator, with good performance also noted for sample-size-adjusted consistent Akaike's information criterion (aCAIC) when the number of participants per class was lower (but at least $n \geq 50$ for aBIC and $n \geq 84$ for aCAIC). In the Yang [43] simulations, BIC and CAIC were also shown to have satisfactory accuracy when the sample sizes were higher. Morovati [44] suggests use of BIC, aBIC, and CAIC

when the sample size is >1000, and both aBIC and BLRT otherwise. On the basis of the simulations mentioned above, we utilized both BIC and CAIC in evaluating the number of classes, and VLMR and BLRT in comparing neighboring models. Lower values of BIC and CAIC pointed towards a better fit to the data.

Furthermore, to limit computational time, and to avoid capitalizing on chance over too many statistical tests, we decided on class enumeration via a two-fold process [42]. First of all, we examined the range of plausible solutions with BIC and CAIC by increasing the number of classes until the lowest value (or an elbow point [40,43]) was identified. Secondly, we tested between competing neighboring models using VLMR and BLRT. In addition, we relied on entropy value as an indicator of the classification quality, with entropy > 0.8 indicative of a clear classification of participants into their most likely classes. Importantly, given the discrepancies between statistical information criteria across situations, we relied heavily on the interpretability of the additional classes in terms of revealing qualitative differences in the shape of the profiles, rather than mere level differences [39,44].

Multinomial logistic regression was used to examine the associations between internet user profiles, individual and social factors, health outcomes, and problematic social media use. The strength of the association was indicated by odds ratio (OR) values. A listwise deletion procedure was used to handle missing data. The significance level was set at $p < 0.05$. Descriptive statistics and multinomial logistic regression analyses were conducted with IBM SPSS Statistics version 26 (IBM, Armonk, NY, USA), and latent class analysis with Mplus version 8.5 (Muthén & Muthén, Los Angeles, CA, USA).

3. Results

3.1. The Prevalence of Internet Activities and Association with Gender (RQ1)

The most prevalent internet activities were listening to music (43.0%), liking posts (40.4%), and talking online (40.2%) (Table 1). Among boys, the most common activities were listening to music (36.3%), talking online (35.9%), and playing games (35.5%), and among girls, liking posts (49.9%), listening to music (49.4%), and talking online (44.3%). Only two of the internet acti vities (browsing and blogging) were not significantly associated with gender.

Table 1. Prevalence of internet activities in total and by gender.

	All	Boys	Girls	
	Several Times a Day % [95 CI]	**Several Times a Day % [95 CI]**	**Several Times a Day % [95 CI]**	**χ^2(df); *p*-Value**
Browse	29.4 [28.0–31.2]	28.0 [25.8–30.3]	30.7 [28.3–33.0]	$\chi^2(6) = 6.3$; 0.281
Like	40.4 [38.7–41.9]	30.3 [28.0–32.5]	49.9 [47.5–52.5]	$\chi^2(6) = 147.0$; <0.001
Listen	43.0 [41.3–44.7]	36.3 [33.8–38.7]	49.4 [47.0–51.8]	$\chi^2(6) = 68.5$; <0.001
Follow	23.2 [21.7–24.6]	16.4 [14.4–18.3]	29.6 [27.3–32.0]	$\chi^2(6) = 135.6$; <0.001
Blog	1.4 [1.0–1.9]	1.5 [0.9–2.2]	1.4 [0.9–1.9]	$\chi^2(6) = 1.7$; 0.891
Info	9.6 [8.7–10.8]	10.8 [9.3–12.3]	8.5 [7.1–9.8]	$\chi^2(6) = 16.2$; 0.006
Comment	9.7 [8.6–10.6]	8.2 [6.9–9.6]	11.0 [9.4–12.6]	$\chi^2(6) = 22.9$; <0.001
Share	7.6 [6.7–8.5]	6.4 [5.1–7.6]	8.7 [7.3–10.0]	$\chi^2(6) = 17.9$; 0.003
Post	12.1 [10.8–13.1]	8.3 [6.9–9.6]	15.6 [13.8–17.4]	$\chi^2(6) = 89.1$; <0.001
Picture	9.8 [8.7–10.9]	6.8 [5.5–8.1]	12.6 [10.9–14.3]	$\chi^2(6) = 172.4$; <0.001
Game	22.4 [21.1–23.9]	35.5 [33.0–38.0]	10.1 [8.7–11.7]	$\chi^2(6) = 630.7$; <0.001
Know people	4.1 [3.4–4.8]	5.5 [4.4–6.6]	2.8 [2.0–3.6]	$\chi^2(6) = 86.7$; <0.001
Company	3.7 [3.4–4.8]	4.2 [3.1–5.2]	3.2 [2.3–4.0]	$\chi^2(6) = 39.4$; <0.001
Video	3.2 [2.6–3.8]	3.8 [2.9–4.8]	2.6 [1.9–3.3]	$\chi^2(6) = 60.3$; <0.001
Music	2.1 [1.6–2.6]	2.6 [1.8–3.4]	1.6 [1.1–2.2]	$\chi^2(6) = 77.2$; <0.001
Talk	40.2 [38.4–41.8]	35.9 [33.4–38.3]	44.3 [41.9–46.7]	$\chi^2(6) = 32.4$; <0.001

3.2. Identification of Internet User Profiles and Differences between Internet User Profiles Regarding Internet Activities (RQ2)

In identifying internet user profiles via LCA, the information criterion BIC suggested up to nine and CAIC up to eight classes. By contrast, VLMR did not show support for increasing the number of classes above five (Table 2). BLRT showed nonconvergence and was not considered. The entropy value was high (>0.85) for all solutions considered. Based on the substantive information provided by the five-class solution, we ended up with five internet user profiles (interest-driven users (n = 302), friendship-driven users (n = 1163), abstinent users (n = 574), irregular users (n = 799), and excessive users (n = 354).

Table 2. Information criterion values of latent class analysis for different internet profile solutions.

	Parameters	LL	BIC	CAIC	Entropy	VLMR
1 class	80	−77,577.33	155,800.12	155,880.74		
2 classes	161	−73,627.99	148,554.94	148,717.19	0.84	
3 classes	242	−71,704.57	145,361.62	145,605.51	0.83	
4 classes	323	−70598.05	143,802.09	144,127.61	0.87	0.00
5 classes	404	−69,711.77	142,683.05	143,090.21	0.86	0.00
6 classes	485	−68,914.44	141,741.91	142,230.69	0.88	0.82
7 classes	566	−68,317.94	141,202.41	141,772.83	0.89	
8 classes	647	−67,802.68	140,825.41	141,477.46	0.88	
9 classes	728	−67,438.32	140,750.22	141,483.90	0.87	
10 classes	809	−67,131.18	140,789.44	141,604.76	0.87	

3.2.1. Interest-Driven Users

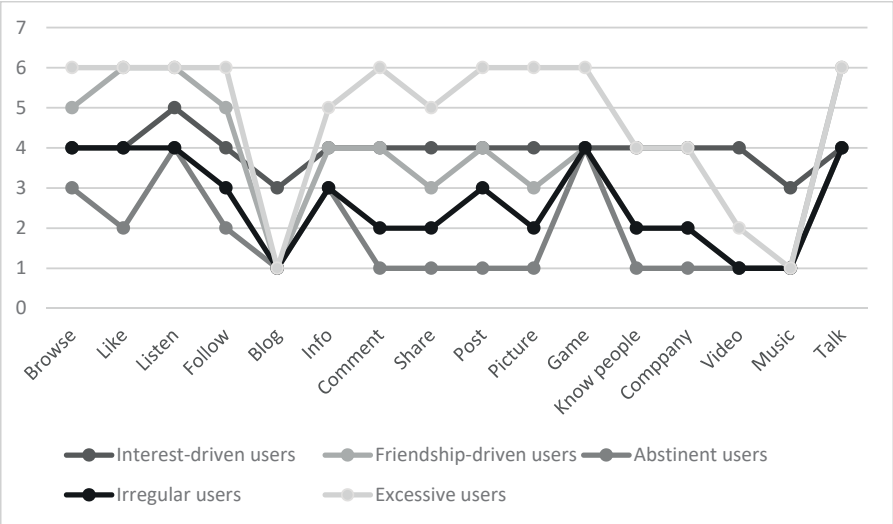
Interest-driven users were reflected through having at least regular but moderate engagement (at least weekly to multiple times a week) in all internet activities (Figures 1 and A1). Thus, they were overall among the most digitally active groups. What distinguished this class was that they reported the highest probability of engaging regularly (even several times a week) in creative and media-oriented activities, such as editing videos, and making and editing music.

3.2.2. Friendship-Driven Users

Friendship-driven users demonstrated moderate to high engagement (from at least several times a week up to several times a day) in socially oriented activities such as liking, talking online, following, commenting, and posting (Figures 1 and A1). As regards other activities, friendship-driven users did not engage in creative and media-oriented activities such as blogging, taking and editing videos, and making and editing music. At the same time, they exhibited low engagement regarding in search of like-minded company and getting to know new people. What distinguished this class from others was their high involvement in socially oriented activities, in contrast to low engagement in creative activities.

3.2.3. Abstinent Users

Abstinent users were reflected through their generally low engagement (from never to once a week) in internet activities. Abstinent users were, in general, the least active group regarding internet use, except for their involvement in listening to music, playing video games, and talking online (Figures 1 and A1).



	Interest-Driven Users	Friendship-Driven Users	Abstinent Users	Irregular Users	Excessive Users
Browse	4	5	3	4	6
Like	4	6	2	4	6
Listen	5	6	4	4	6
Follow	4	5	2	3	6
Blog	3	1	1	1	1
Info	4	4	3	3	5
Comment	4	4	1	2	6
Share	4	3	1	2	5
Post	4	4	1	3	6
Picture	4	3	1	2	6
Game	4	4	4	4	6
Know people	4	2	1	2	4
Comppany	4	2	1	2	4
Video	4	1	1	1	2
Music	3	1	1	1	1
Talk	4	6	4	4	6

Figure 1. Medians for internet activities within the internet user profiles (1 = never, 2 = less than once a week, 3 = once a week, 4 = several days a week, 5 = every day once a day, and 6 = several times every day).

3.2.4. Irregular Users

Irregular users reported no particularly high engagement in any internet activity; however, they showed more variation in their activity than abstinent users. The irregular users reported low to moderate engagement (less than once a week to several times a week) in socially oriented activities such as liking, talking online, following, commenting, sharing, and posting, and also in interest-driven activities such as browsing and searching for info (Figures 1 and A1). Irregular users also reported moderate engagement (at least several times a week) in playing video games. What distinguished irregular users from other internet user profiles was their erratic participation in most internet activities.

3.2.5. Excessive Users

Excessive users formed the most active internet user profile with at least moderate, often excessive involvement (at least daily to several times a day) in many internet activities, including liking, following, commenting, sharing, posting, talking online, searching for

information, and playing video games (Figures 1 and A1). Excessive users regularly got to know people and looked for people with similar interests. They were the most active group in taking and editing pictures.

3.3. Internet User Profiles Associated with Individual and Social Factors (RQ3), Health Outcomes, and Problematic Social Media Use (RQ4)

In the sample, the most normative internet user profile was that of friendship-driven users (36.4%) (Table 3). All the variables, except self-rated health, were associated with internet user profiles. Regarding individual factors, gender differences were found. Girls were more likely to be friendship-driven users, whereas boys were more likely to be interest-driven, abstinent, and irregular users. Adolescents aged 13 and 15 years old were more likely to be friendship- and interest-driven users, whereas 11 year olds were more likely to be abstinent and irregular users. Participants with high health literacy were most likely to be excessive users and adolescents with high academic achievement were most likely to be friendship-driven users. Adolescents with low academic achievement were most likely to be interest-driven users.

Table 3. Internet user profiles association with individual factors, social factors, health outcomes, and problematic social media use.

		Interest-Driven Users (*n* = 302)	**Friendship-Driven Users (*n* = 1163)**	**Abstinent Users (*n* = 574)**	**Irregular Users (*n* = 799)**	**Excessive Users (*n* = 354)**	
		% [95% CI]	**% [95% CI]**	**% [95% CI]**	**% [95% CI]**	**% (95% CI)**	**χ^2(df); *p*-Value**
All		9.5 [8.4–10.5]	36.4 [34.8–38.2]	18.0 [16.7–19.3]	25.0 [23.7–26.5]	11.1 [10.0–12.2]	
Gender	Girl	32.1 [26.8–37.5]	66.5 [63.9–69.2]	41.8 [37.6–45.9]	43.6 [40.2–47.1]	52.3 [47.2–57.7]	χ^2 (4) = 190.3; <0.001
	Boy	67.9 [62.5–73.2]	33.5 [30.8–36.1]	58.2 [54.1–62.4]	56.4 [52.9–59.8]	47.7 [42.3–52.8]	
Age	15	40.1 [34.8–45.4]	39.0 [36.1–41.8]	27.5 [24.0–31.2]	23.5 [20.7–26.4]	39.1 [34.0–44.5]	χ^2 (8) = 143.5; <0.001
	13	35.4 [30.1–40.7]	40.0 [37.1–43.0]	32.6 [28.7–36.2]	35.7 [32.3–38.9]	37.7 [32.6–42.8]	
	11	24.5 [19.9–29.5]	21.1 [18.7–23.4]	39.9 [36.1–43.9]	40.8 [37.3–44.4]	23.2 [18.7–27.5]	
Family affluence	High	18.6 [14.5–23.1]	19.2 [16.9–21.6]	16.2 [13.1–19.5]	16.0 [13.4–18.7]	24.7 [20.6–29.7]	χ^2 (8) = 35.2; <0.001
	Medium	57.9 [52.1–63.4]	63.1 [60.1–66.2]	56.8 [52.6–61.0]	59.2 [55.4–62.5]	54.7 [49.1–59.6]	
	Low	23.4 [18.6–28.6]	17.8 [15.5–20.0]	27.0 [23.1–30.6]	24.8 [22.2–28.0]	20.6 [16.3–25.0]	
Health literacy	High	28.1 [21.4–35.2]	39.2 [36.1–42.6]	29.0 [23.9–34.0]	26.0 [21.5–30.4]	49.4 [42.6–55.7]	χ^2 (8) = 77.17; <0.001
	Medium	57.1 [49.5–63.8]	55.1 [51.7–58.5]	56.6 [50.8–62.0]	66.3 [61.6–71.3]	43.4 [37.0–49.4]	
	Low	14.8 [10.2–19.9]	5.7 [4.1–7.4]	14.5 [10.8–18.9]	7.7 [5.9–10.4]	7.2 [3.8–10.6]	
Academic achievement	High	13.9 [9.6–18.8]	33.1 [30.3–36.2]	22.9 [18.7–27.4]	27.9 [23.7–31.8]	26.7 [22.1–31.8]	χ^2 (8) = 67.6; <0.001
	Medium	44.2 [37.5–51.0]	47.7 [44.4–51.1]	46.4 [40.7–51.5]	47.3 [42.7–51.9]	43.8 [38.0–49.6]	
	Low	41.8 [35.1–48.6]	19.2 [16.4–21.7]	30.7 [25.6–36.1]	24.8 [20.7–28.8]	29.5 [24.0–35.3]	
Peer support	High	56.0 [49.4–61.8]	74.9 [72.3–77.5]	58.9 [54.5–63.2]	65.3 [61.8–68.6]	73.1 [67.6–77.9]	χ^2 (8) = 69.5; <0.001
	Medium	31.7 [26.3–37.1]	18.8 [16.5–21.1]	27.5 [23.8–31.4]	24.8 [21.9–27.9]	18.3 [14.1–22.8]	
	Low	12.4 [8.1–17.0]	6.3 [4.9–7.7]	13.6 [10.7–16.7]	9.9 [7.7–12.1]	8.7 [5.8–12.2]	
Family support	High	58.9 [53.1–64.9]	74.9 [72.1–77.5]	73.0 [68.5–76.8]	76.9 [73.7–80.0]	68.4 [62.9–73.5]	χ^2 (8) = 40.5; <0.001
	Medium	28.7 [23.0–34.0]	17.9 [15.7–20.2]	18.1 [14.9–21.6]	15.8 [13.2–18.6]	24.2 [19.4–29.4]	
	Low	12.5 [8.7–16.6]	7.2 [5.8–8.9]	8.9 [6.6–11.4]	7.3 [5.3–9.2]	7.4 [4.5–10.6]	
Parental monitoring	High	44.5 [37.4–52.2]	28.5 [25.2–32.2]	30.6 [25.0–35.9]	33.5 [28.9–38.1]	34.1 [27.7–40.5]	χ^2 (8) = 25.9; <0.001
	Medium	30.2 [23.6–36.8]	34.6 [31.2–38.1]	31.3 [25.7–36.6]	36.6 [31.7–41.5]	29.1 [23.2–35.0]	
	Low	25.3 [19.2–31.9]	36.9 [33.8–40.5]	38.0 [32.4–43.7]	29.9 [25.3–34.5]	36.8 [30.0–43.2]	
Self-rated health	Good	84.4 [80.1–88.4]	86.2 [83.9–88.0]	86.4 [83.6–89.2]	86.4 [84.0–88.6]	81.0 [76.8–85.3]	χ^2 (4) = 7.3; 0.123
	Poor	15.6 [11.6–19.9]	13.8 [12.0–16.1]	13.6 [10.8–16.4]	13.6 [11.4–16.0]	19.0 [14.7–23.2]	
Feeling low	Less than	64.2 [58.9–69.9]	61.2 [58.6–63.9]	75.6 [72.1–78.7]	72.3 [69.2–75.7]	53.8 [48.4–59.2]	χ^2 (4) = 73.6; <0.001
	More than	35.8 [30.1–41.1]	38.8 [36.1–41.4]	24.4 [21.3–27.9]	27.7 [24.3–30.8]	46.2 [40.8–51.6]	
Tired on school mornings	Less than	66.6 [61.3–71.9]	66.3 [63.6–69.2]	74.0 [70.2–77.7]	75.5 [72.2–78.6]	63.2 [58.4–68.0]	χ^2 (4) = 32.6; <0.001
	More than	33.4 [28.1–38.7]	33.7 [30.8–36.4]	26.0 [22.3–29.8]	24.5 [21.4–27.8]	36.8 [32.0–41.6]	
Social media use	No risk	44.3 [38.1–50.2]	51.6 [48.7–54.5]	73.1 [69.1–76.8]	63.8 [60.3–67.3]	38.4 [32.8–44.0]	χ^2 (8) = 231.2; <0.001
	moderate risk	33.2 [27.7–38.4]	39.9 [37.1–42.7]	22.1 [18.7–25.8]	32.1 [28.7–35.5]	43.4 [38.1–48.7]	
	Problematic	22.5 [17.6–27.7]	8.5 [7.0–10.2]	4.7 [3.1–6.5]	4.1 [2.8–5.5]	18.2 [14.1–22.0]	

As regards social factors, participants with high peer support were more likely to be friendship-driven and excessive users, whereas adolescents with high family support were more likely to be irregular, friendship-driven, and abstinent users. Adolescents with high parental monitoring were most likely to be interest-driven users.

In terms of health outcomes, self-rated health was not associated with the internet user profiles. However, adolescents feeling low and tired on school mornings were most likely to be excessive users. Adolescents feeling low less than weekly were most likely to be abstinent and irregular users.

Participants belonging to the problematic social media user group were most likely to be interest-driven and excessive users, whereas participants belonging to the moderate risk group were most likely to be excessive and friendship-driven users.

Table 4 presents the results of the multinomial logistic regression. The friendship-driven user group was used as the reference group, as it was the most normative. As regards individual factors, boys were four times more likely to be interest-driven users and almost three times more likely to be abstinent or irregular users than to be friendship-driven users (Table 4). Adolescents aged 11 years old were three times more likely to be abstinent users and over three times more likely to be irregular users than friendship-driven users. Participants with low health literacy were almost three times more likely to be abstinent users compared to the reference group. Moreover, adolescents with low academic achievement were over four times more likely to be interest-driven users than friendship-driven users. As regards social factors, adolescents with low peer support were almost three times more likely to be abstinent users compared to the reference group. Participants belonging to the problematic social media user group were over three times more likely to be interest-driven users and almost three times more likely to be excessive users compared to friendship-driven users.

Table 4. Multinomial logistic regression on the associations between internet user profiles, individual and social factors, health outcomes, and problematic social media use using friendship-driven users as the reference group.

	Interest-Driven Users	**Abstinent Users**	**Irregular Users**	**Excessive Users**
	OR [95% CI]	**OR [95% CI]**	**OR [95% CI]**	**OR [95% CI]**
Sex				
Girls	1	1	1	1
Boys	4.06 [2.99–5.50]	2.73 [2.17–3.45]	2.58 [2.09–3.18]	1.93 [1.48–2.53]
Age:				
15	1	1	1	1
13	0.92 [0.66–1.29]	1.15 [0.87–1.51]	1.46 [1.14–1.87]	1.00 [0.75–1.34]
11	1.43 [0.98–2.08]	2.96 [2.22–3.94]	3.50 [2.69–4.55]	1.11 [0.78–1.58]
Family affluence				
High	1	1	1	1
Medium	0.87 [0.59–1.27]	0.96 [0.71–1.31]	1.02 [0.77–1.34]	0.70 [0.51–0.98]
Low	1.31 [0.83–2.06]	1.54 [1.07–2.20]	1.59 [1.15–2.21]	0.89 [0.59–1.34]
Health literacy				
High	1	1	1	1
Medium	1.10 [0.74–1.62]	1.27 [0.92–1.74]	1.67 [1.25–2.24]	0.54 [0.39–0.75]
Low	1.84 [0.96–3.54]	2.80 [1.63–4.82]	1.83 [1.05–3.19]	0.86 [0.45–1.65]
Academic achievement				
High	1	1	1	1
Medium	1.82 [1.12–2.95]	1.32 [0.94–1.87]	1.05 [0.78–1.42]	1.32 [0.91–1.93]
Low	4.41 [2.62–7.41]	2.06 [1.37–3.11]	1.60 [1.11–2.30]	2.18 [1.39–3.41]

Table 4. *Cont.*

	Interest-Driven Users	Abstinent Users	Irregular Users	Excessive Users
Peer support				
High	1	1	1	1
Medium	1.40 [0.98–1.99]	1.66 [1.25–2.21]	1.43 [1.10–1.85]	0.81 [0.57–1.16]
Low	1.62 [0.89–2.94]	2.74 [1.70–4.44]	1.94 [1.22–3.08]	1.19 [0.66–2.15]
Family support				
High	1	1	1	1
Medium	2.27 [1.58–3.26]	1.13 [0.82–1.55]	1.02 [0.76–1.36]	1.75 [1.25–2.45]
Low	1.61 [0.88–2.96]	0.68 [0.40–1.13]	0.69 [0.43–1.12]	1.11 [0.61–2.04]
Parental monitoring				
High	1	1	1	1
Medium	0.75 [0.50–1.14]	1.04 [0.70–1.46]	0.97 [0.71–1.33]	0.78 [0.52–1.15]
Low	0.61 [0.39–0.95]	1.25 [0.87–1.79]	0.83 [0.60–1.15]	0.77 [0.52–1.14]
Self-rated health				
Good	1	1	1	1
Poor	1.15 [0.78–1.68]	1.39 [1.01–1.90]	1.29 [0.97–1.71]	1.26 [0.90–1.76]
Feeling low				
Less than weekly	1	1	1	1
More than weekly	0.81 [0.60–1.09]	0.61 [0.47–0.78]	0.69 [0.55–0.85]	1.20 [0.91–1.58]
Tired				
Less than 4 times a week	1	1	1	1
More than 4 times a week	0.88 [0.65–1.19]	0.91 [0.71–1.17]	0.74 [0.60–0.93]	0.92 [0.70–1.21]
Social media use				
No risk	1	1	1	1
Moderate risk	1.03 [0.76–1.38]	0.43 [0.34–0.55]	0.72 [0.59–0.88]	1.40 [1.06–1.83]
Problematic	3.31 [2.26–4.85]	0.43 [0.27–0.69]	0.45 [0.29–0.69]	2.70 [1.84–3.96]

4. Discussion

Using a nationally representative sample from Finland, the study elucidated the prevalence of adolescents' internet use. It identified five internet user profiles and analyzed how these were related to individual and social factors, health outcomes, and problematic social media use. The study represents one of the few to employ a person-oriented approach, approaching the matter from an interindividual standpoint.

Internet use is common among adolescents, with 45% of teens being almost constantly online [14]. In general, adolescents spent most time engaging in entertainment (listening to music) and in socially oriented activities (talking online, liking) and less time on complex and technically demanding activities (taking and editing videos, making and editing music). These findings are supported also by the findings of the Pew Research Center [14]. Due to the accessibility of smartphones and the development of the information society, it has become possible for adolescents to stay constantly connected [45] and to carry their entire entertainment libraries in their pockets; thus, they can engage in social and entertainment-oriented activities more frequently. As regards gender, our study suggests that socially oriented activities (liking, talking online, following, commenting, posting) are more common among girls, whereas video gaming and media-oriented activities (taking and editing videos, making and editing music) are more common among boys.

Five internet user profiles were identified: interest-driven users, friendship-driven users, abstinent users, irregular users, and excessive users. The profile structures, which reflected the genres of participation identified by Ito et al. [5] and the typologies studied by Brandtzæg [6], were somewhat similar to the profiles of Hietajärvi et al. [7]. Interest-driven use resembled the media-oriented participation identified by Hietajärvi et al. [7], and was reflected through more complex activities related to creating and sharing media

(pictures, videos, music). In contrast, friendship-driven use in this study resembled the social networking-oriented participation identified by Hietajärvi et al. [7], or the friendship-driven "hanging out" described by Ito et al. [5], motivated by the desire to communicate with friends through social media. Abstinent users and irregular users were contrasted with the category of "sporadics" identified by Brandtzæg [6]. Note, however, that within our study, irregular users were more versatile in their use than abstinent users, who leaned more towards "non-users" except in terms of some forms of entertainment (listening to music and playing games). Excessive users participated intensively in internet activities, apart from complex, media-oriented activities and blogging. In previous studies, the most excessive user group often overlapped with the most advanced user group in terms of the complex nature of the preferred activities [6], with activities also linked to other activities such as high engagement in social media and in interest-related searching. This makes the excessive user group identified in the present study somewhat different, insofar as they were less engaged in technically demanding activities. Note also that in our study, video gaming was measured by only one item. This may have had an effect on the profile structures, bearing in mind that in the study by Hietajärvi et al. [7] (for example), two video gaming-related user profiles were identified, namely "action gaming" and "social gaming".

The internet user profiles differed in terms of individual and social factors, health outcomes, and the prevalence of problematic social media use. Beyens [3] found that the effects of internet use differed between individual adolescents, and this appeared to also be the case in our study. Moreover, it has been suggested that schools may tend to alienate digitally engaged students [46], and this was supported by our finding that adolescents in the interest-driven user group were most likely to be students with low academic achievement. It should be noted that low academic achievement might also be explained through an energy-depletion process related to an imbalance between adolescents' resources and the demands of schoolwork [47]. In contrast, adolescents in the friendship-driven user group were likely participants with high peer support and were more likely to be girls, a finding in line with the study conducted by Inchley [9] wherein girls were more likely than boys to communicate with friends online. Given that the benefits of internet use include increased social capital [15] and social support [16], friendship-driven use may overall be beneficial for adolescent health.

The profiles encompassing lesser participation in internet activities (including abstinent and irregular users) were more likely to be found among 11 year olds. The developmental level might be an explanatory factor in the age distribution of the profiles, insofar as younger adolescents have had less time to experience the different forms of internet use.

The model of compensatory internet use theorizes that the negative outcomes related to internet use may be due to attempts to escape real life [48]. In contrast, Valkenburg and Peter [49] argue that the effects of the internet are based on individual susceptibilities. In our study, the negative health outcomes ("feeling low" and "being tired on school mornings") were more common among active participants in internet activities (the excessive users and the interest- and friendship-driven users) than among abstinent and irregular users. Negative health outcomes were most common among excessive users; nevertheless, self-rated health was not associated with the profiles.

The adolescents with problematic social media use were three times more likely to be interest-driven users and almost three times more likely to be excessive users, in comparison with the friendship-driven users (Table 4). Overall, the evidence indicates that moderate to high socially oriented internet use does not intrinsically predict problematic social media use. However, compared to more passive user profiles (the abstinent and irregular users), the actively participating profiles were more likely to belong to the at-risk and problematic social media user groups. Persons working with young people should be adept at identifying content and qualitative differences in internet use and the various contexts of use, since the intensity of use is not the only predictor of health outcomes or of problematic social media use.

The present study has several strengths. For instance, we employed a large, nationally representative sample in conjunction with a person-oriented approach. This offered multiple benefits, bearing in mind that the majority of studies on adolescent internet use have so far been variable-oriented. Our approach thus sheds new light on the phenomenon, with the individual taken as the unit of the analysis. Another strength of the study is the use of internationally validated variables. However, the study had certain limitations. First, it can be argued that self-report instruments may not give a sufficiently objective view of adolescents' internet activity, due to the risk of their overly emphasizing the amount of activity [50]. Second, the intensity scale—ranging from never participating to participating several times a day—may not have given sufficient information on the intensity of internet use. Use of the internet several times a day has in fact become the status quo; in this sense, using this criterion as a measurement of intensive use creates the risk of falsifying the results. In future studies, one could seek to use objective measurements of the time and frequency of internet use in addition to the content and quality of screen time. The tools would include objective measurement of time spent online via smartphone application tracking apps, detailed time-diary methods, or repeated-experience sampling methods. In addition, longitudinal research on the direction of the association between internet user profiles and health outcomes should be studied.

5. Conclusions

The study accomplished its objectives in terms of using a person-oriented approach to study the prevalence of adolescents' internet use. Entertainment activities and socially oriented activities were the most prevalent among adolescents, but gender differences emerged. Additionally, the study successfully identified five different internet user profiles (encompassing interest-driven, friendship-driven, abstinent, irregular, and excessive users). The study also confirmed differences between the internet user profiles in terms of individual and social factors, health outcomes, and problematic social media use. In the future, we suggest that objective measurement tools such as smartphone application tracking apps could be used to gain more detailed insights into the qualitative and quantitative aspects of adolescents' internet use. Furthermore, longitudinal research on the direction of the association between internet user profiles and health outcomes should be conducted.

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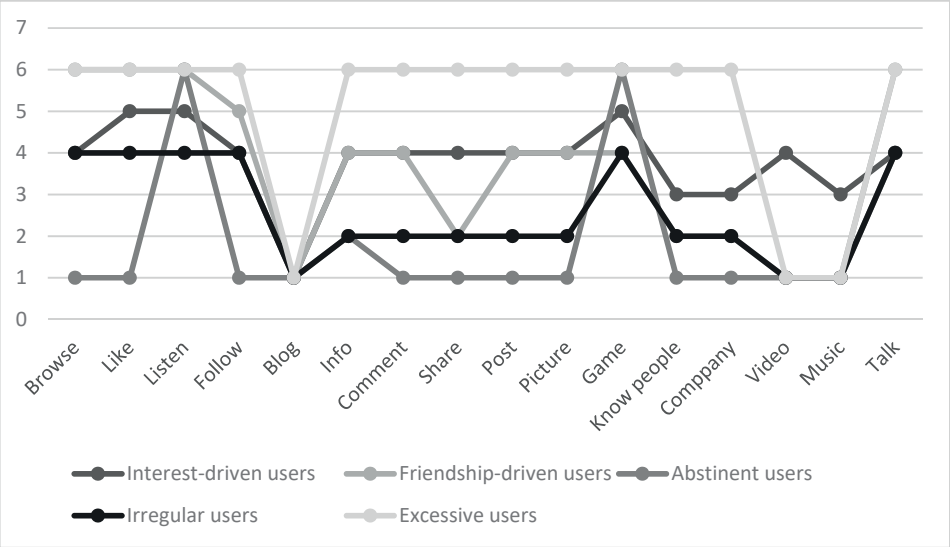
Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and approved by the Ethical Committee of the University of Jyväskylä (19 February 2018).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Conflicts of Interest: The authors declare no conflict of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript, or in the decision to publish the results.

Appendix A



	Interest-Driven Users	Friendship-Driven Users	Abstinent Users	Irregular Users	Excessive Users
Browse	4	6	1	4	6
Like	5	6	1	4	6
Listen	5	6	6	4	6
Follow	4	5	1	4	6
Blog	1	1	1	1	1
Info	4	4	2	2	6
Comment	4	4	1	2	6
Share	4	2	1	2	6
Post	4	4	1	2	6
Picture	4	4	1	2	6
Game	5	4	6	4	6
Know people	3	2	1	2	6
Comppany	3	2	1	2	6
Video	4	1	1	1	1
Music	3	1	1	1	1
Talk	4	6	4	4	6

Figure A1. Modes for internet activities within the internet user profiles (1 = never, 2 = less than once a week, 3 = once a week, 4 = several days a week, 5 = every day once a day, and 6 = several times every day).

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II

WHAT COUNTERACTS PROBLEMATIC SOCIAL MEDIA USE IN ADOLESCENCE? A CROSS-NATIONAL OBSERVATIONAL STUDY

by

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What Counteracts Problematic Social Media Use in Adolescence? A Cross-National Observational Study

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A B S T R A C T

Purpose: Social media use has increased rapidly during the past decade, raising concerns about adolescents who display problematic social media use (PSMU), as indicated by addiction-like symptoms (e.g., preoccupation, tolerance). We aimed to assess the extent to which an individual resource (health literacy), and social resources (friend support and family support), moderated the association between a range of individual characteristics (gender, age, family affluence, and depressive feelings) and PSMU; also the association between PSMU and health outcomes (self-rated health, life satisfaction, and sleep difficulties), both cross-nationally and nationally.
Methods: Our sample included 22,226 adolescents from six European countries. We used data from the Health Behaviour in School-aged Children cross-sectional survey (2017/2018). Random-effects models and moderator analyses were applied.
Results: Six moderations were found, with the resources moderating the association between individual characteristics and PSMU. One moderation emerged cross-nationally, namely that a higher level of family support was associated with a lower likelihood of PSMU, especially among adolescents who did not have frequent depressive feelings. In addition, five national moderations were identified. For example, a higher level of health literacy was associated with a lower likelihood of PSMU among Finnish girls. The resources were also found to moderate the association between PSMU and health outcomes, with two moderations emerging cross-nationally. For instance, a higher level of family support was related to higher self-rated health, especially among problematic users. In addition, nine national moderations were identified; these included a higher

IMPLICATIONS AND CONTRIBUTION

A strong body of research demonstrates that if left untreated, problematic social media use (PSMU) can substantially harm adolescent health and wellbeing. These results suggest that health literacy, family support, and friend support have the potential to moderate the associations between individual characteristics and PSMU and also the association between PSMU and health outcomes in adolescence.

Conflicts of interest: The authors declare they have no conflicts of interest.
Data Sharing: The HBSC survey data that were used in this study are available at https://www.uib.no/en/hbscdata from October 2022, subject to the approval of the Data Manager of the HBSC study (https://www.uib.no/en/hbscdata). The statistical analyses will be available at https://orcid.org/0000-0002-1877-4712 on acceptance for publication.
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level of health literacy being associated with having less sleep difficulties, especially among problematic users in Germany.

Discussion: In adolescence, health literacy, family support, and friend support have the potential to moderate the association between individual characteristics and PSMU, and between PSMU and health outcomes, cross-nationally and nationally. We recommend the use of universal and targeted interventions to promote individual and social resources to counteract PSMU.

Social media have become strongly integrated into adolescents' daily lives [1]. Adolescents routinely report that the social media make them feel more connected to their friends, thus fostering a more complete sense of social self-identity [2]. Nevertheless, concerns have been raised about adolescents who display problematic social media use (PSMU), as indicated by addiction-like symptoms including preoccupation (i.e., considerable time spent on thinking about the activity), tolerance, withdrawal, persistence (i.e., relapse), escape from negative feelings, conflict, displacement of activities, problems in important life domains, and deception [3,4]. In the cross-national Health Behaviour in School-aged Children (HBSC) study conducted in 2018, which included data from 45 countries, 4%–18% of 15-year-olds reported PSMU [5]. A solid evidence base suggests that if untreated, PSMU can seriously threaten adolescent health and wellbeing [6,7]. There have been calls for approaches aimed at identifying those adolescents who are more prone to digital threats such as PSMU and finding ways to counteract the negative outcomes [8,9]. Theoretical support has been derived from the Differential Susceptibility to Media Effects Model (DSMM), which was developed to explain why some individuals are more susceptible than others to media effects and to indicate how the media effects can be counteracted [10].

The DSMM combines, systematizes, and expands on previous media-effects theories. It comprises an integrated set of propositions that describe the association between media-related variables (such as PSMU) and nonmedia variables. According to the model, media effects are conditional on dispositional, developmental, and social susceptibility, together labeled as differential susceptibility variables. Dispositional susceptibility encompasses all personal dimensions that could predispose to media use, such as gender, personality traits, moods, cognitions, values, and motivations. Developmental susceptibility is characterized as emotional, social, and cognitive development that could influence media use. Finally, social susceptibility includes all social-context factors that could be related to media use. The DSMM assigns two roles to differential susceptibility variables. First, they can work as predictors of media use. Second, they can reduce or stimulate media-related outcomes through moderation [10].

As suggested by the model, differential susceptibility variables (i.e., individual characteristics) play a substantial role in explaining why some adolescents are more susceptible to PSMU. Cross-national findings indicate that girls are more likely than boys to have higher levels of PSMU [5], with national studies showing that girls also have a higher risk of developing PSMU [11]. Furthermore, PSMU seems to increase with age, with 13-year-olds and 15-year-olds reporting more problematic use than their younger counterparts (aged 11 years) [11]. In addition, adolescents from less affluent families in certain countries report more PSMU [5], and research indicates that adolescents who are relatively more deprived are more susceptible to PSMU [12]. Cross-national and single-country studies have also shown that adolescents with frequent depressive feelings show higher levels of PSMU [11,13,14]. Given that individual characteristics are associated with PSMU, it has been deemed essential to identify and study adolescents with the characteristics in question (i.e., adolescents in vulnerable situations), with the aim of lessening health disparities [8,9,15].

Adolescence has also been recognized as a critical period for major developmental tasks; these include acquiring the emotional and cognitive abilities for independence and for forming life-long relationships, but they also involve risk behavior and susceptibilities [16]. So far, only a few studies have examined those differential susceptibility variables that could work as individual resources (e.g., Paakkari et al.) [11] and social resources (e.g., Boniel-Nissim et al.) [14]. The difference as compared to many other differential susceptibility variables (e.g., gender, age) is that the resources can be developed through education, interventions, and policies aimed at protecting adolescents from PSMU. For such investigations, the DSMM [10] suggests modeling the resources as *moderator variables*, the aim being to explain systematic variations in how the resources influence—and possibly counteract—PSMU and associated negative health outcomes. With this aim in view, the present study aimed to investigate whether health literacy and social support from family and friends can moderate the association between individual characteristics and PSMU, and furthermore, the association between PSMU and health outcomes in adolescence (Figure 1) [10].

Health literacy as an individual resource refers to personal knowledge and competencies (mediated by the availability of resources and by organizational structures) that enable people to access, understand, appraise, and use services and information in ways that promote and maintain wellbeing and good health for themselves and others around them [17]. Previous studies have shown that health literacy operates as a mediator [18] and as a moderator [19] and has the potential to promote positive health as well as to protect adolescents from negative health behavior and negative health outcomes. Higher health literacy has also been shown to have a negative association with PSMU (e.g., Paakkari et al.) [11]. Furthermore, health literacy can be developed through education; hence, it belongs to the potential factors that might help to decrease unfair and avoidable disparities in health [17]. There have therefore been calls for further research on whether health literacy can counteract PSMU and its negative health consequences [11]. It should also be noted that adolescence comprises a valuable period in life for promoting health literacy because it is the phase in which independent

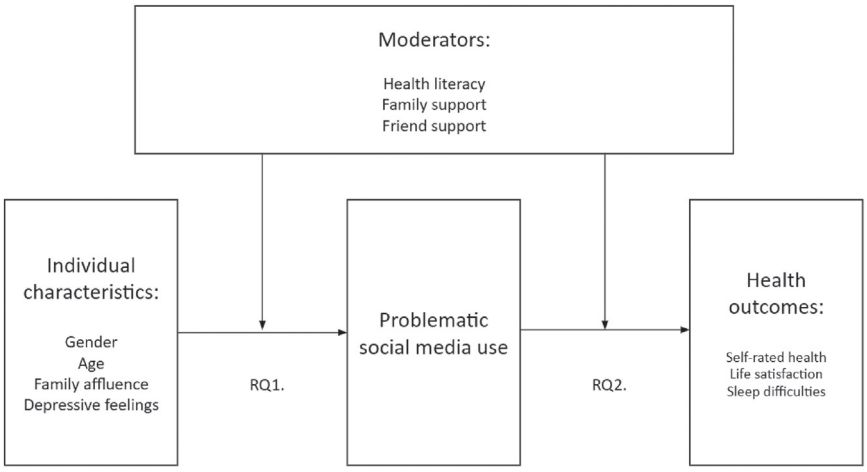


Figure 1. The moderations of health literacy, family support, and friend support in the associations between individual characteristics and PSMU, and between PSMU and health outcomes. Theoretical support has been derived from the Differential Susceptibility to Media Effects Model [10].

decision-making develops [20], and in which the foundation for health behavior, health, and wellbeing is laid [16].

Substantial evidence exists for the protective role of social support (comprising a social susceptibility variable) regarding adverse health outcomes (e.g., Rueger et al.) [21]. For instance, high levels of social support were linked to higher life satisfaction and less psychosomatic complaints in an international study that examined adolescent risk behaviors and their association with adolescent mental wellbeing [22]. Perceived social support has also been shown to be negatively associated with PSMU [23] and to have the potential to work as a moderator in the association between the social determinants of health and PSMU [12].

Because adolescence is a period marked by rapid changes and growth, friend and family contexts may provide different types of social support. In adolescence, one begins to move away from the family and to approach the peer group to a greater degree [2]. However, at the same time, family support does not cease to be significant at this stage. The adolescent thus needs diverse sources of support to overcome the challenges of adolescence [21]. Consequently, consideration of different sources of support—including family and peer contexts—is important for understanding whether social support can counteract PSMU and associated negative health outcomes during adolescence [14].

To our knowledge, no study has so far investigated the extent to which individual resources (such as health literacy) and social resources (such as family support and friend support) could moderate and possibly counteract digital threats such as PSMU and its negative health consequences during adolescence. As noted above, these are resources which might be influenced through education and interventions. Furthermore, cross-national and single-country studies have indicated that individual characteristics play a role in the development of PSMU [5,11,14]. There would therefore be a good reason to pay attention to how the resources in question are linked to individuals in vulnerable situations. These could include girls, adolescents of a higher age, adolescents with lower family affluence [5], and adolescents with depressive symptomology [13].

In the present study, both cross-national and national perspectives were adopted, because country-level variation was expected, and because this could potentially enhance the appropriate targeting of policy, intervention, and prevention efforts. Based on the existing literature, we hypothesized that cross-nationally and nationally, health literacy, family support, and friend support would moderate the association between (1) individual characteristics and PSMU and (2) the association between PSMU and health outcomes. Specifically, we hypothesized the resources which might counteract PSMU, especially among adolescents who are in vulnerable situations in terms of PSMU, and which might enhance health outcomes especially among problematic social media users, with reduced health disparities as a consequence [8,9,15]. In line with the hypotheses, the specific research questions for the study were framed as follows:

RQ1: Do health literacy, family support, and friend support moderate the association between individual characteristics (gender, age, family affluence, and depressive feelings) and PSMU?

RQ2: Do health literacy, family support, and friend support moderate the association between PSMU and health outcomes (self-rated health [SRH], life satisfaction, and sleep difficulties)?

Methods

Study design and data sources

The data were collected as part of the HBSC study (a collaborative cross-sectional survey with World Health Organization, examining adolescents' health and wellbeing, and repeated every four years in more than 50 countries). We made use of the latest 2017/2018 data, which included nationally representative samples of 13-year-old and 15-year-old adolescents from six European countries: Finland (n = 2,194), Germany (n = 2,922), Belgium (n = 2,688), Estonia (n = 3,147), the Czech Republic (n = 7,768), and Poland (n = 3,507). Countries that included all the study variables in their 2017/2018 survey were included. These countries strictly adhered to the sampling method and data collection procedures of the HBSC international research protocol, which involved random selection of schools and classes for sampling [24]. The surveys were administered during school hours in classroom settings, and participation was anonymous and voluntary. The participating countries obtained ethical

approval from their institutional ethics committee for the study procedures [24].

Problematic social media use

PSMU was measured via the nine-item Social Media Disorder Scale, which assesses symptoms of addiction (such as preoccupation and tolerance) using a dichotomous (No/Yes) answer scale. The cut-off value for the problematic user group was six or more "yes" answers [4]. Based on the values obtained, the respondents were categorized into two groups: a *nonproblematic* use group = 0 and a *problematic* use group = 1, in line with Boer et al. [25]. The scale has been found to be reliable, valid, and cross-nationally comparable [3]. The internal consistency of the scale was adequate (with Cronbach's alpha ranging from 0.72 to 0.84 between countries).

Individual characteristics

Self-reported gender (boy = 0; girl = 1) and age (13 years = 0; 15 years = 1) were measured by asking participants to select the correct alternative.

The Family Affluence Scale (FAS) III [26] measured the self-reported socioeconomic position. FAS III includes six items: ownership of a car, ownership of a dishwasher, having one's own bedroom, number of family computers, number of family bathrooms, and number of family vacations during the past 12 months. The computed scores were recoded into two categories to indicate relative family affluence: high family affluence (highest 80%) = 0 and low family affluence (lowest 20%) = 1. The relative family affluence was studied in line with the suggestions of Elgar et al. [27], in addition to the HBSC international report [28]. The scale was dichotomized to allow appropriate group-level comparison, here bearing in mind adolescents in vulnerable situations and possible inequities [8,9,15]. The FAS III has been validated and shown to be appropriate in adolescent studies [26].

The depressive feelings variable was measured as part of the HBSC symptoms checklist [29]. The responses ranged from 1 = *rarely or never* to 5 = *about every day*. The responses were categorized into two groups. Hence, the responses *feeling low rarely or never* and *feeling low monthly* were combined and labeled as *not having frequent depressive feelings*= 0. The responses *feeling low about every week*, *more than once a week*, and *about every day* were combined and labeled as having *frequent depressive feelings* = 1. The variable was dichotomized to allow appropriate group-level comparison, again bearing in mind adolescents in vulnerable situations and possible inequities [8,9,15]. The item has been validated in an adolescent sample and has been found to have adequate reliability [30].

Sample distributions for individual characteristics are shown in Table A1.

Individual and social resources as moderators

Health literacy was measured by the Health Literacy for School-Aged Children instrument [31,32]. The scale consists of 10 items (e.g., "I have good information about health") and measures adolescents' perceived competencies and knowledge to make health-related decisions. The range of responses is from 1 = *not at all true* to 4 = *absolutely true*. The response values were summed, and the sum score (ranging from 10 to 40 points) was used as a continuous scale [32]. The internal consistency of the items was good (with Cronbach's alpha ranging from 0.83 to 0.96 between countries).

Family support [33] was measured via a multidimensional scale consisting of four items on perceived support: (1) emotional support, (2) talking about problems with the family, (3) the family's willingness to help in making decisions, and (4) family help. The scale ranged from 1 = *very strongly disagree* to 7 = *very strongly agree*. The scale (continuous) was calculated via the sum score. The scale has been validated in adolescent samples [34,35]. The internal consistency of the items was very good (with Cronbach's alpha ranging from 0.91 to 0.97 between countries).

Friend support [33] was measured via a multidimensional scale consisting of four items on perceived support: (1) emotional support, (2) talking about problems with friends, (3) being able to count on friends, and (4) friends' help. The scale ranged from 1 = *very strongly disagree* to 7 = *very strongly agree*. The scale (continuous) was calculated via the sum score. The scale has been validated in adolescent samples [34,35]. The internal consistency of the items was good (with Cronbach's alpha ranging from 0.89 to 0.96 between countries).

Health outcomes

Self-rated health (SRH) was measured by a single question on the individual's evaluation and perception of their health [36]. The response options were *poor, fair, good,* and *excellent*. SRH was treated as a continuous variable. SRH has been shown to be a robust item [37] and valid in adolescent samples [38].

Life satisfaction was measured via a single question in which respondents rated their life satisfaction using Cantril's ladder [39]. The responses ranged from 0 (= *worst possible life*) to 10 (= *best possible life*). Life satisfaction was treated as a continuous variable. The scale has been validated in adolescent samples and has exhibited adequate validity and reliability [40].

Sleep difficulty was measured as part of the HBSC symptoms checklist [29]. The response options ranged from 1 (= *rarely or never*) to 5 (= *about every day*). Sleep difficulty was treated as a continuous variable, and the outcome was inverted to correspond to other health outcomes. The item has been validated in adolescent samples and has exhibited adequate reliability [30].

Statistical analyses

Basic data-screening activities were performed before any analyses were conducted. Missing data ranged from 6.2% to 26.3% in the analyses. The majority of the analyses had a moderate level of missing data, with values between 6% and 15%. The only analyses containing more than 20% missing data were those from the Czech Republic with health literacy as the moderator. To address this, the analyses were conducted using both a Complete Case Analysis (CCA) and imputation. Both sets of analyses yielded similar results; thus, the analyses using CCA were found to facilitate reproducibility [41].

As a first step, regression analyses were performed to test the associations between individual characteristics and PSMU (Table A2) and the association between PSMU and health outcomes (Table A3). Second, the resources (health literacy, family support, and friend support) were added to the regression models (RQ1, Table A4; RQ2, Table A5). Third, interaction terms were constructed for RQ1 ($B_{\text{individual characteristic}^{*}\text{resource}}$) and RQ2

Table 1
The moderations of health literacy, family support, and friend support in the associations between individual characteristics and PSMU; cross-nationally

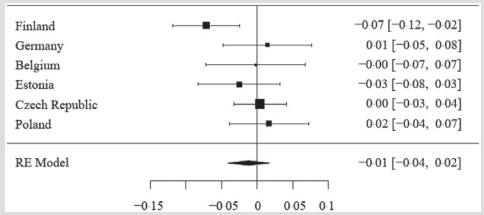
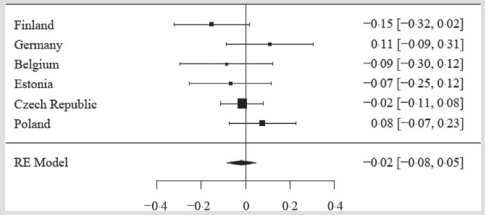
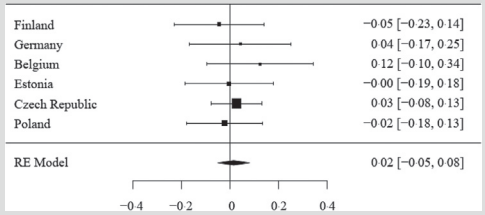
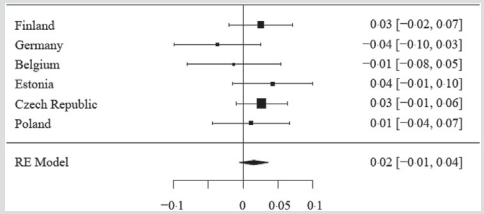
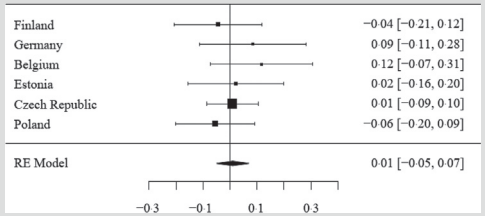
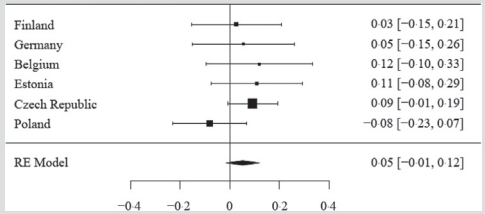
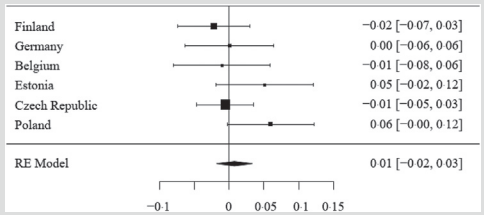
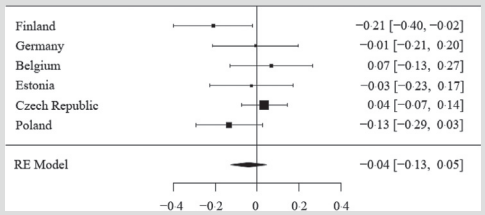
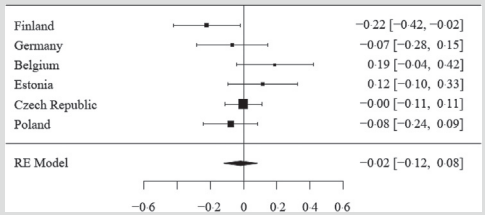
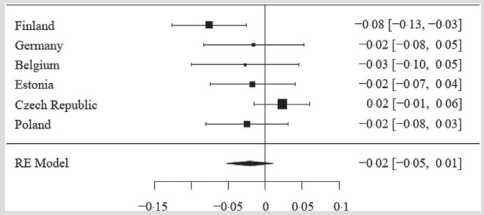
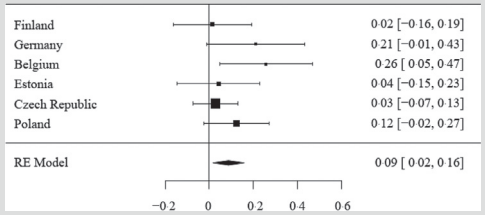
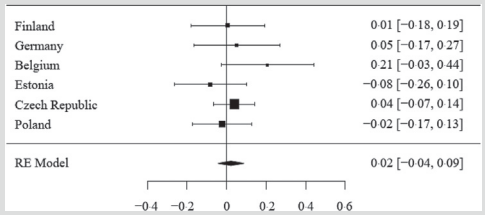
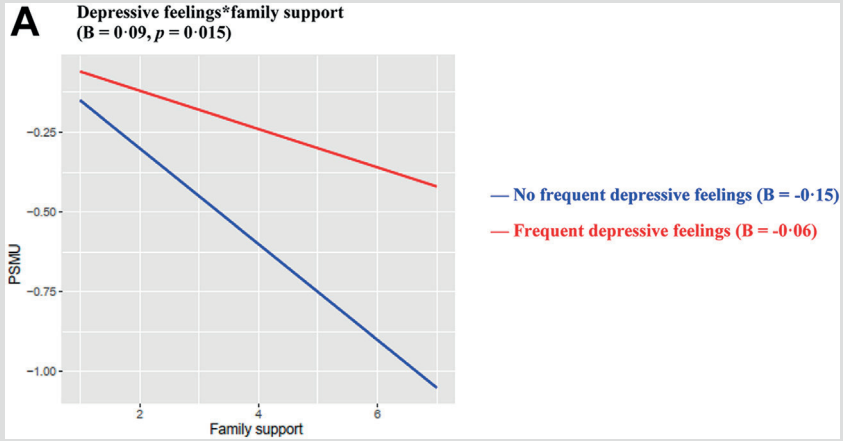
	Health literacy	Family support	Friend support
Gender			
Age			
Family affluence			
Depressive feelings			

Table 1
Continued

Health literacy	Family support	Friend support
		

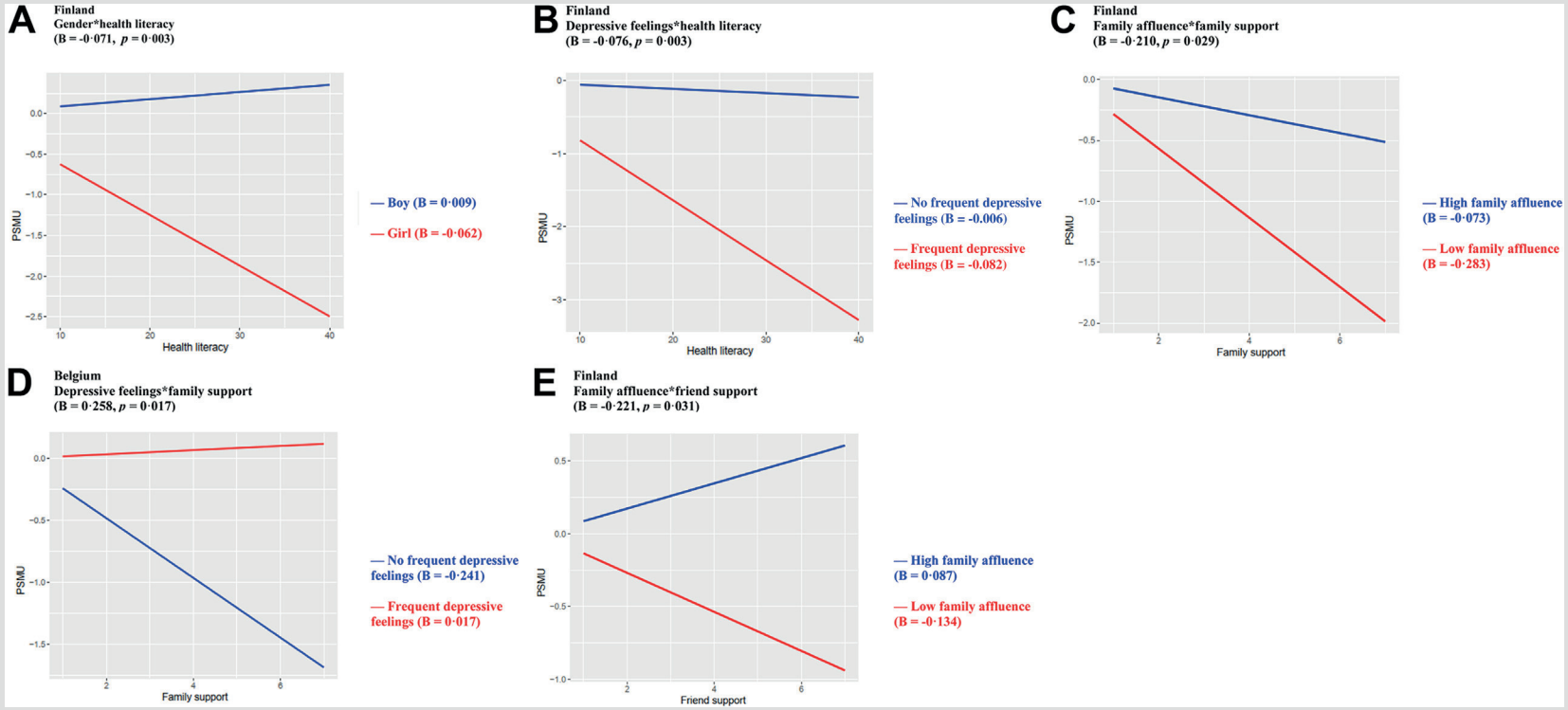
Regression formula (e.g., in the case of frequent depressive feelings, the estimated effect of family support on PSMU is $B_{\text{family support}} + B_{\text{depressive feelings*family support}} = -0.15 + 0.09 = -0.06$; cross-nationally).
Graphic representation of the moderations.

Table 2
The moderations of health literacy, family support, and friend support in the associations between individual characteristics and PSMU; nationally

	Finland			Germany			Belgium			Estonia			Czech Republic			Poland		
	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*
Models: Health literacy as the moderator																		
HL	0.009	0.019	.63	−0.063	0.021	.003**	−0.050	0.028	.074	−0.044	0.022	.043*	−0.048	0.014	< .001***	−0.049	0.021	.020*
Gender	2.461	0.784	.002**	−0.631	0.911	.49	0.605	1.060	.57	0.976	0.860	.26	0.120	0.548	.83	−0.117	0.851	.89
Gender * HL	−0.071	0.024	.003**	0.014	0.032	.65	−0.002	0.035	.95	−0.025	0.029	.39	0.004	0.019	.83	0.017	0.028	.56
			$R^2 = 0.029$			$R^2 = 0.025$			$R^2 = 0.035$			$R^2 = 0.020$			$R^2 = 0.024$			$R^2 = 0.029$
			$\Delta R^2 = 0.006$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
HL	−0.044	0.016	.008**	−0.041	0.021	.046*	−0.045	0.024	.070	−0.076	0.019	< .0001***	−0.059	0.013	< .0001***	−0.046	0.020	.021*
Age	−0.687	0.748	.36	0.636	0.912	.49	0.231	1.027	.82	−1.346	0.861	.12	−0.787	0.548	.15	−0.528	0.851	.53
Age * HL	0.025	0.023	.27	−0.037	0.032	.24	−0.013	0.034	.70	0.043	0.029	.15	0.027	0.019	.15	0.012	0.028	.68
			$R^2 = 0.023$			$R^2 = 0.025$			$R^2 = 0.036$			$R^2 = 0.020$			$R^2 = 0.025$			$R^2 = 0.029$
			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$
HL	−0.026	0.014	.061	−0.057	0.020	.004**	−0.047	0.022	.032*	−0.068	0.016	< .0001***	−0.044	0.011	< .0001***	−0.057	0.017	< .001***
FAS	0.721	0.837	.39	0.041	0.934	.96	0.273	1.053	.80	−1.488	1.051	.16	0.142	0.596	.81	−1.836	0.953	.054
FAS * HL	−0.022	0.027	.41	0.000	0.033	.99	−0.011	0.036	.77	0.051	0.036	.15	−0.006	0.021	.78	0.060	0.032	.058
			$R^2 = 0.023$			$R^2 = 0.024$			$R^2 = 0.035$			$R^2 = 0.020$			$R^2 = 0.024$			$R^2 = 0.030$
			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$
HL	−0.006	0.015	.71	−0.052	0.019	.005**	−0.042	0.021	.051	−0.051	0.020	.009**	−0.055	0.012	< .0001***	−0.029	0.019	.13
Depressive	3.026	0.808	< .001***	1.569	0.991	.11	1.910	1.086	.079	1.203	0.853	.16	0.419	0.559	.45	1.681	0.851	.048*
Depressive * HL	−0.076	0.026	.003**	−0.015	0.035	.66	−0.027	0.037	.47	−0.017	0.029	.56	0.023	0.019	.23	−0.025	0.028	.38
			$R^2 = 0.030$			$R^2 = 0.025$			$R^2 = 0.036$			$R^2 = 0.019$			$R^2 = 0.024$			$R^2 = 0.030$
			$\Delta R^2 = 0.008$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$
Models: Family support as the moderator																		
Family	−0.042	0.066	.52	−0.210	0.070	.003**	−0.104	0.090	.25	−0.168	0.076	.027*	−0.079	0.038	.038*	−0.183	0.062	.003**
Gender	0.939	0.493	.057	−0.862	0.562	.13	0.925	0.605	.13	0.496	0.533	.35	0.324	0.255	.20	−0.037	0.396	.93
Gender * Family	−0.153	0.086	.077	0.110	0.100	.27	−0.087	0.106	.41	−0.068	0.094	.47	−0.015	0.049	.76	0.076	0.077	.32
			$R^2 = 0.022$			$R^2 = 0.019$			$R^2 = 0.034$			$R^2 = 0.019$			$R^2 = 0.018$			$R^2 = 0.030$
			$\Delta R^2 = 0.002$			$\Delta R^2 = 0.002$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
Family	−0.103	0.059	.083	−0.196	0.069	.004**	−0.225	0.071	.002**	−0.220	0.065	< .001***	−0.092	0.034	.007**	−0.106	0.054	.051
Age	0.336	0.460	.47	−0.918	0.558	.10	−0.742	0.533	.16	−0.315	0.499	.53	−0.009	0.248	.97	−0.030	0.381	.94
Age * Family	−0.045	0.083	.59	0.086	0.101	.39	0.118	0.097	.22	0.022	0.090	.82	0.009	0.049	.85	−0.055	0.074	.46
			$R^2 = 0.020$			$R^2 = 0.018$			$R^2 = 0.034$			$R^2 = 0.019$			$R^2 = 0.018$			$R^2 = 0.030$
			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
Family	−0.073	0.050	.14	−0.155	0.065	.017*	−0.187	0.062	.002**	−0.202	0.056	< .001***	−0.097	0.028	< .001***	−0.094	0.046	.042*
FAS	1.143	0.515	.026 *	0.111	0.568	.84	−0.406	0.546	.46	0.045	0.533	.93	−0.052	0.282	.85	0.488	0.399	.22
FAS * Family	−0.210	0.097	.029 *	−0.007	0.104	.94	0.069	0.101	.49	−0.026	0.102	.79	0.035	0.056	.53	−0.133	0.081	.10
			$R^2 = 0.023$			$R^2 = 0 \cdot .018$			$R^2 = 0.033$			$R^2 = 0.019$			$R^2 = 0.018$			$R^2 = 0.031$
			$\Delta R^2 = 0.004$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$
Family	−0.130	0.053	.014 *	−0.221	0.060	< .001***	−0.241	0.058	< .0001***	−0.230	0.067	< .001***	−0.097	0.029	< .001***	−0.198	0.055	< .001***
Depressive	0.527	0.479	.27	−0.101	0.593	.86	−0.228	0.559	.68	0.355	0.521	.50	0.820	0.261	.002**	0.266	0.386	.49
Depressive * Family	0.015	0.091	.87	0.212	0.113	.06	0.258	0.108	.017 *	0.042	0.095	.66	0.029	0.053	.59	0.124	0.076	.10
			$R^2 = 0.019$			$R^2 = 0.019$			$R^2 = 0.036$			$R^2 = 0.018$			$R^2 = 0.018$			$R^2 = 0.030$
			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.003$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
Models: Friend support as the moderator																		
Friend	0.052	0.071	.46	−0.169	0.077	.028*	−0.119	0.087	.17	−0.121	0.071	.090	−0.100	0.043	.020*	−0.010	0.065	.88
Gender	0.375	0.540	.49	−0.361	0.583	.53	−0.145	0.628	.82	0.217	0.498	.66	0.133	0.258	.61	0.427	0.361	24
Gender * Friend	−0.046	0.094	.63	0.043	0.107	.68	0.124	0.112	.27	−0.003	0.093	.97	0.027	0.054	.62	−0.023	0.080	78
			$R^2 = 0.016$			$R^2 = 0.020$			$R^2 = 0.029$			$R^2 = 0.014$			$R^2 = 0.017$			$R^2 = 0.024$
			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
Friend	0.014	0.064	.83	−0.171	0.071	.016*	−0.098	0.074	.18	−0.168	0.061	.005**	−0.132	0.037	< .001***	0.014	0.053	.79
Age	−0.068	0.527	.90	−0.740	0.577	.20	−0.755	0.619	.22	−0.706	0.507	.16	−0.329	0.251	.19	0.108	0.348	.76
Age * Friend	0.027	0.092	.77	0.054	0.105	.61	0.119	0.109	.28	0.108	0.093	.25	0.093	0.051	.072	−0.080	0.076	.29
			$R^2 = 0.016$			$R^2 = 0.020$			$R^2 = 0.029$			$R^2 = 0.015$			$R^2 = 0.018$			$R^2 = 0.025$
			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
Friend	0.087	0.057	.13	−0.124	0.066	.062	−0.106	0.066	.11	−0.150	0.053	.004**	−0.083	0.030	.006**	−0.003	0.045	.96
FAS	1.288	0.566	.023 *	0.417	0.585	.48	−1.005	0.663	.13	−0.608	0.581	.30	0.137	0.278	.62	0.225	0.379	.55

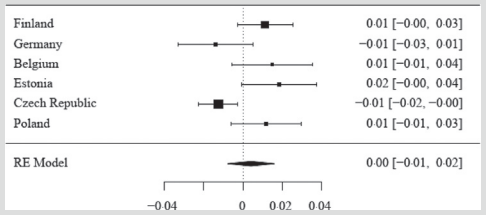
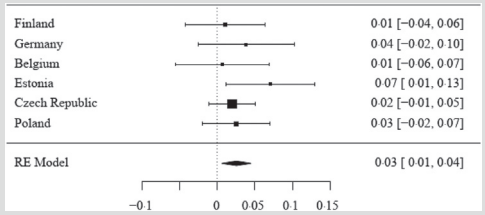
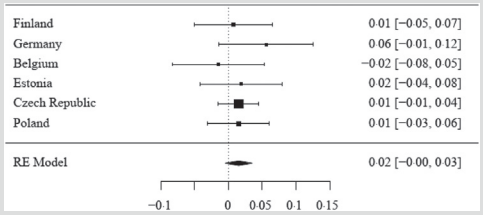
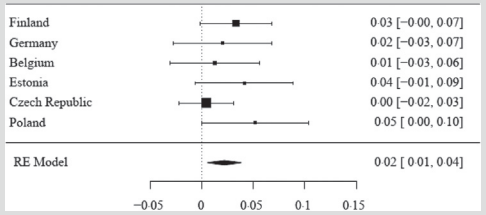
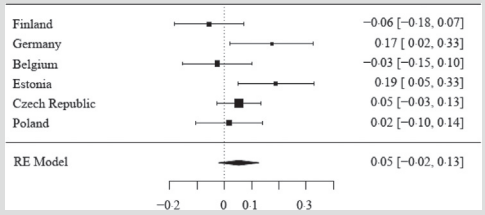
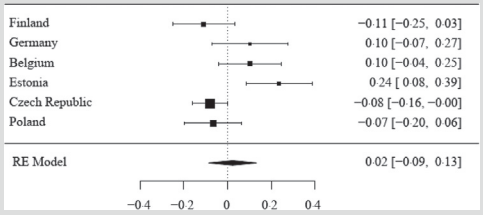
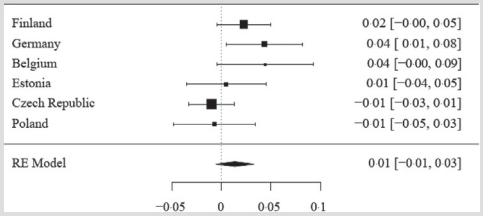
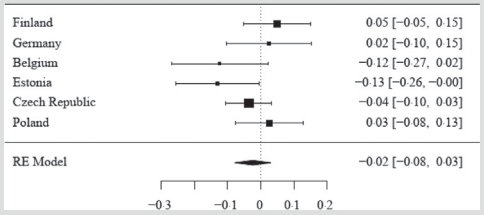
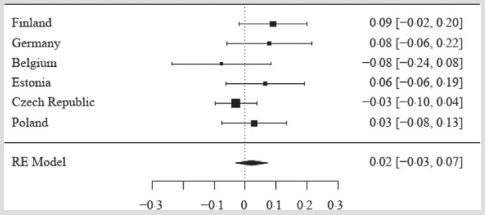
Table 2
Continued

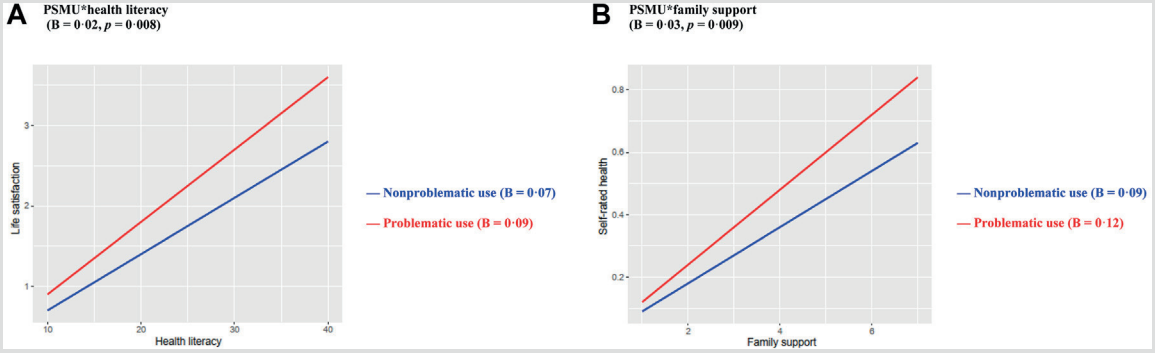
	Finland			Germany			Belgium			Estonia			Czech Republic			Poland		
	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*
FAS * Friend	−0.221	0.103	.031 * $R^2 = 0.019$ $\Delta R^2 = 0.003$	−0.067	0.109	.54 $R^2 = 0.021$ $\Delta R^2 = 0.001$	0.190	0.118	.11 $R^2 = 0.030$ $\Delta R^2 = 0.002$	0.115	0.108	.29 $R^2 = 0.015$ $\Delta R^2 = 0.001$	−0.001	0.057	.99 $R^2 = 0.017$ $\Delta R^2 = 0.000$	−0.078	0.085	.36 $R^2 = 0.024$ $\Delta R^2 = 0.000$
Friend	0. 024	0. 061	.69	−0.164	0.065	.012*	−0.111	0.066	.091	−0.083	0.066	.21	−0.097	0.032	.003**	−0.014	0.053	.80
Depressive	0. 750	0.543	.17	0.792	0.593	.18	0.066	0.658	.92	1.148	0.500	.022*	0.795	0.261	.002**	1.038	0.351	.003**
Depressive * Friend	0.006	0.095	.95 $R^2 = 0.016$ $\Delta R^2 = 0.000$	0.051	0.111	.64 $R^2 = 0.020$ $\Delta R^2 = 0.000$	0.207	0.119	.082 $R^2 = 0.031$ $\Delta R^2 = 0.003$	−0.081	0.093	.38 $R^2 = 0.015$ $\Delta R^2 = 0.001$	0.038	0.053	.47 $R^2 = 0.017$ $\Delta R^2 = 0.000$	−0.023	0.077	.77 $R^2 = 0.024$ $\Delta R^2 = 0.000$



Regression formula (e.g., when family affluence is low, the estimated effect of family support on problematic SMU is $B_{\text{family support}} + B_{\text{family affluence*family support}} = -0.073 + -0.210 = -0.283$ in Finland).
Individual characteristics were controlled (e.g., if the interaction term was gender*health literacy, control was applied to age, family affluence, and depressive feelings).
Graphic representations of the moderations.

Table 3
The moderations of health literacy, family support, and friend support in the associations between PSMU and health outcomes; cross-nationally

	Health literacy	Family support	Friend support
Self-rated health			
Life satisfaction			
Sleep difficulty			



Regression formula (e.g., among problematic social media users, the estimated effect of health literacy on life satisfaction is $B_{\text{health literacy}} + B_{\text{PSMU*health literacy}} = 0.07 + 0.02 = 0.09$; cross-nationally).
Graphic representations of the moderations.

($B_{PSMU^*resource}$) to investigate whether health literacy, family support, and friend support moderated the association between individual characteristics and PSMU and between PSMU and health outcomes (Figure 1). Multiple sets of stratified analyses were performed to find the most suitable regression models. For example, we tested step-by-step whether the moderator variables and interaction terms should be included in a single model within the country-level analyses or tested separately. Based on the model performance, consistency, interpretability [42], and the underlying construct of "social support" within the friend support and family support variables [33], separate models were chosen. The analyses were performed for each of the six countries separately. The regression coefficients of the variables were used to examine the nature of the associations. If the regression coefficient of the interaction term was significant ($p < .05$), this was taken to indicate a moderation [43]. Tjur's R^2 [44] was calculated when the outcome was the categorical PSMU, while Adjusted R^2 was used when the outcomes were the continuous health indicators.

Cross-national associations and moderations were examined via meta-analytic techniques. The aim was to synthesize the results from the six European countries by (1) pooling the regression coefficients of the variables and interaction terms, (2) calculating their respective standard errors, and (3) examining the directions and magnitude of the outcomes via effect sizes. The random-effects model was chosen for three reasons: (1) we aimed at generalizing the results beyond the countries included, (2) true homogeneity between countries could not be assumed, and (3) each estimate was assumed to have a different underlying true effect, and these effects to have a distribution [45]. Forest plots were created to highlight the results. The analyses were performed using metafor [46] and base packages on R-software [47].

Results

In the cross-national analyses, gender and depressive feelings (i.e., individual characteristics; Table A2) and health literacy, family support, and friend support (i.e., resources; Table A4) were significantly associated with PSMU. Only depressive feelings, health literacy, and family support were associated with PSMU in all the countries studied in the national analyses. In relation to other individual characteristics and to friend support, the statistically significant associations showed national variations. PSMU (Table A3), health literacy, family support, and friend support (Table A5) were significantly associated with all the measured health outcomes, both cross-nationally and nationally.

The moderations of health literacy, family support, and friend support in the associations between individual characteristics and PSMU (RQ1)

One significant moderation emerged cross-nationally (Table 1). The forest plots from the random-effects models demonstrated family support as moderating the association between depressive feelings and PSMU across all countries ($B_{depressive\ feelings^*family\ support} = 0.09$, $p = .015$). Higher family support was more strongly associated with a lower likelihood of PSMU among adolescents with no frequent depressive feelings ($B = -0.15$) than among adolescents with frequent depressive feelings ($B = -0.06$); nevertheless, it was related to a lower likelihood of PSMU in both groups.

Nationally, moderations emerged in Finland and Belgium (Table 2). Health literacy emerged as a moderator in the association between gender ($B_{gender^*health\ literacy} = -0.071$, $p = .003$) and PSMU, and also in the association between depressive feelings ($B_{depressive\ feelings^*health\ literacy} = -0.076$, $p = .003$) and PSMU in Finland. Higher health literacy was related to a lower likelihood of PSMU among Finnish girls ($B = -0.062$) and Finnish adolescents with frequent depressive feelings ($B = -0.082$) (i.e., adolescents in a vulnerable situation regarding PSMU).

Family support ($B_{family\ affluence^*family\ support} = -0.210$, $p = .029$) and friend support ($B_{family\ affluence^*friend\ support} = -0.221$, $p = .031$) emerged as moderators in the association between family affluence and PSMU in Finland. Higher family support and friend support were associated with a lower likelihood of PSMU among adolescents from families with low affluence (family support, $B = -0.283$; friend support, $B = -0.134$). In Belgium, family support was observed as a moderator in the association between depressive feelings and PSMU ($B_{depressive\ feelings^*family\ support} = 0.258$, $p = .017$). Higher family support was related to a higher likelihood of PSMU among adolescents with frequent depressive feelings ($B = 0.017$), but to a lower likelihood among adolescents with no frequent depressive feelings ($B = -0.241$).

The moderations of health literacy, family support, and friend support in the associations between PSMU and health outcomes (RQ2)

Two significant cross-national moderations emerged, such that health literacy acted as a moderator in the association between PSMU and life satisfaction ($B_{PSMU^*health\ literacy} = 0.02$, $p = .008$), and family support acted as a moderator in the association between PSMU and SRH ($B_{PSMU^*family\ support} = 0.03$, $p = .009$) (Table 3). Across the six countries, differences emerged between problematic and nonproblematic users; hence, higher health literacy was found to relate more strongly to higher life satisfaction, and higher family support to higher SRH among problematic users (health literacy, $B = 0.09$; family support, $B = 0.12$) as compared to nonproblematic users (health literacy, $B = 0.07$; family support, $B = 0.09$).

Nine significant moderations emerged in the national analyses (Table 4). Health literacy was observed as a moderator in the association between PSMU and SRH ($B_{PSMU^*health\ literacy} = -0.013$, $p = .014$) in the Czech Republic. Higher health literacy was more strongly associated with higher SRH among nonproblematic ($B = 0.027$) than among problematic users ($B = 0.014$). In Poland, health literacy emerged as a moderator in the association between PSMU and life satisfaction ($B_{PSMU^*health\ literacy} = 0.052$, $p = .049$). Having a higher level of health literacy was related to higher life satisfaction among both problematic users and nonproblematic users, although the association was stronger among problematic users ($B = 0.143$ vs. nonproblematic users, $B = 0.091$). In Germany, health literacy ($B_{PSMU^*health\ literacy} = 0.044$, $p = .027$) acted as a moderator in the association between PSMU and sleep difficulties. Higher health literacy was more strongly associated with having less sleep difficulties among problematic users ($B = 0.063$) than among nonproblematic ($B = 0.019$) users.

Family support emerged as a moderator in the association between PSMU and SRH ($B_{PSMU^*family\ support} = 0.070$, $p = .020$) and between PSMU and sleep difficulties ($B_{PSMU^*family\ support} = -0.130$, $p = .043$) in Estonia. Higher family support was related to higher SRH in both groups, but the association was

stronger among problematic users (B = 0.211; nonproblematic users, B = 0.141). By contrast, in terms of having less sleep difficulties, the association with higher family support was stronger among nonproblematic users (nonproblematic users, B = 0.277 vs. problematic users, B = 0.147). Family support also emerged as a moderator in the association between PSMU and life satisfaction in Estonia ($B_{PSMU*family\ support}$ = 0.189, p = .008) and in Germany ($B_{PSMU*family\ support}$ = 0.173, p = .028). In both countries, higher family support was associated with higher life satisfaction in both groups, but the relation was stronger among problematic users (Estonia, B = 0.760; Germany B = 0.567) than among nonproblematic users (Estonia, B = 0.571; Germany B = 0.394).

Friend support emerged as a moderator in the association between PSMU and life satisfaction in Estonia ($B_{PSMU*friend\ support}$ = 0.235, p = .002) and in the Czech Republic ($B_{PSMU*friend\ support}$ = −0.080, p = .046). In Estonia, higher friend support was more strongly related to higher life satisfaction among problematic users (B = 0.508) than among nonproblematic users (B = 0.273). By contrast, in the Czech Republic, higher friend support was associated with lower life satisfaction among problematic users (B = −0.017), but it made higher life satisfaction more likely among nonproblematic users (B = 0.063).

Discussion

To our knowledge, this is so far the only study providing evidence on the degree to which health literacy, family support, and friend support moderate (1) the association between individual characteristics and PSMU and (2) the association between PSMU and health outcomes in a large cross-national cohort. Hence, the study fills a gap in the literature, namely the lack of studies on the individual and social resources that can be developed through education and intervention in efforts to moderate and possibly counteract digital threats such as PSMU [8,9] and its negative health consequences [6,7,11,14]. It was for this purpose that we applied the DSMM [10]. Collectively, our findings provide support for the notion that among adolescents, PSMU and its negative health consequences can be moderated and counteracted by (in particular) health literacy and family support and (in some instances) friend support. The findings relate to both national and cross-national contexts. They point to possible life-long benefits for adolescent health, and thus respond to the calls made by Clark et al. [8] and Kickbusch et al. [9].

As regards our first research question, the resources under study appeared capable of decreasing disparities in health by benefiting adolescents who have vulnerabilities related to PSMU. For example, higher health literacy was associated with benefits among girls [5,11,14] and among adolescents with frequent depressive feelings [13] in Finland (Table 2, Graph A and B). As regards our second research question, the cross-national analyses indicated that health literacy and family support have the potential to narrow the gap in health disparities between problematic and nonproblematic users, bearing in mind that, for example, higher family support was more strongly associated with higher SRH among problematic users than among nonproblematic users (Table 3, Graph B). Such findings provided support for our hypothesis that the resources examined would be more beneficial for adolescents who have greater PSMU-related vulnerability and could enhance health outcomes, especially among problematic social media users.

Nevertheless, a closer examination showed that in some cases, improvements in resources may paradoxically widen the disparities between groups. This “prevention dilemma” (Boccia and Ricciardi) [48] could be seen particularly in the cross-national analyses whereby higher family support was more strongly associated with a lower likelihood of PSMU among adolescents with no frequent depressive feelings than among adolescents with frequent depressive feelings (Table 1, Graph A). On the other hand, one must consider these findings together with cross-national findings indicating positive links between health literacy, family support, and friend support with regard to (1) a lesser likelihood of PSMU and (2) all health outcomes. The findings in this regard would seem to underline the importance of promoting equity over equality per se. This approach—which has been termed “proportionate universalism” [15]—highlights the need to prioritize groups who are already at a disadvantage in efforts to decrease unfair and avoidable disparities in health. In relation to our setting, this would imply a combination of both universal and targeted interventions and health policies, aimed at addressing PSMU and associated health outcomes.

In addition, cross-national and national variation occurred regarding the extent to which the resources benefited different groups of adolescents. In some instances, the resources were associated with reduced health disparities cross-nationally, but similar effects were not systematically detected in the national analyses. For instance, in the cross-national analyses, higher family support was related to higher SRH, with greater benefit among problematic users than among nonproblematic users (Table 3, Graph B). However, with regard to individual countries, only Estonia showed a statistically significant effect in this respect (Table 4, Graph D). Similarly, while health literacy narrowed the health disparities between problematic and nonproblematic users in the cross-national analyses (Table 3, Graph A), some contrary findings were identified in the national analyses (as in the case of the Czech Republic, where higher health literacy was more strongly associated with higher SRH among nonproblematic users than among problematic users; Table 4, Graph A). This raises the question of whether it is ethically sustainable to devote resources to regional interventions (e.g., similar interventions to all countries) if countries do not benefit equally. Similarly, it broadens our earlier discussion on universal approaches to PSMU and related health challenges. However, to advance the discussion on regional approaches, there will be a need for further exploration of cross-national and country-level differences.

Our study had a number of strengths. These include the use of a large-scale, cross-nationally representative sample of adolescents and validated variables. Furthermore, the study used a suitable theoretical framework and was built upon a strong evidence base suggesting that PSMU substantially harms adolescent health and wellbeing [6,7,11,14] and that individual [17] and social resources [21,23] have the potential to counteract adverse health behaviors and health outcomes. In addition, moderator analyses were performed, and random-effects models were used to target cross-national effects.

However, several limitations should be acknowledged. The cross-sectional design cannot establish causality. Moreover, all the measures were based on self-report instruments, which are susceptible to bias. Since they were collected in 2018, they might not encompass variations in the current status of adolescents given, for example, the rapid changes in social media use during the COVID-19 pandemic. It should also be noted that the effect sizes

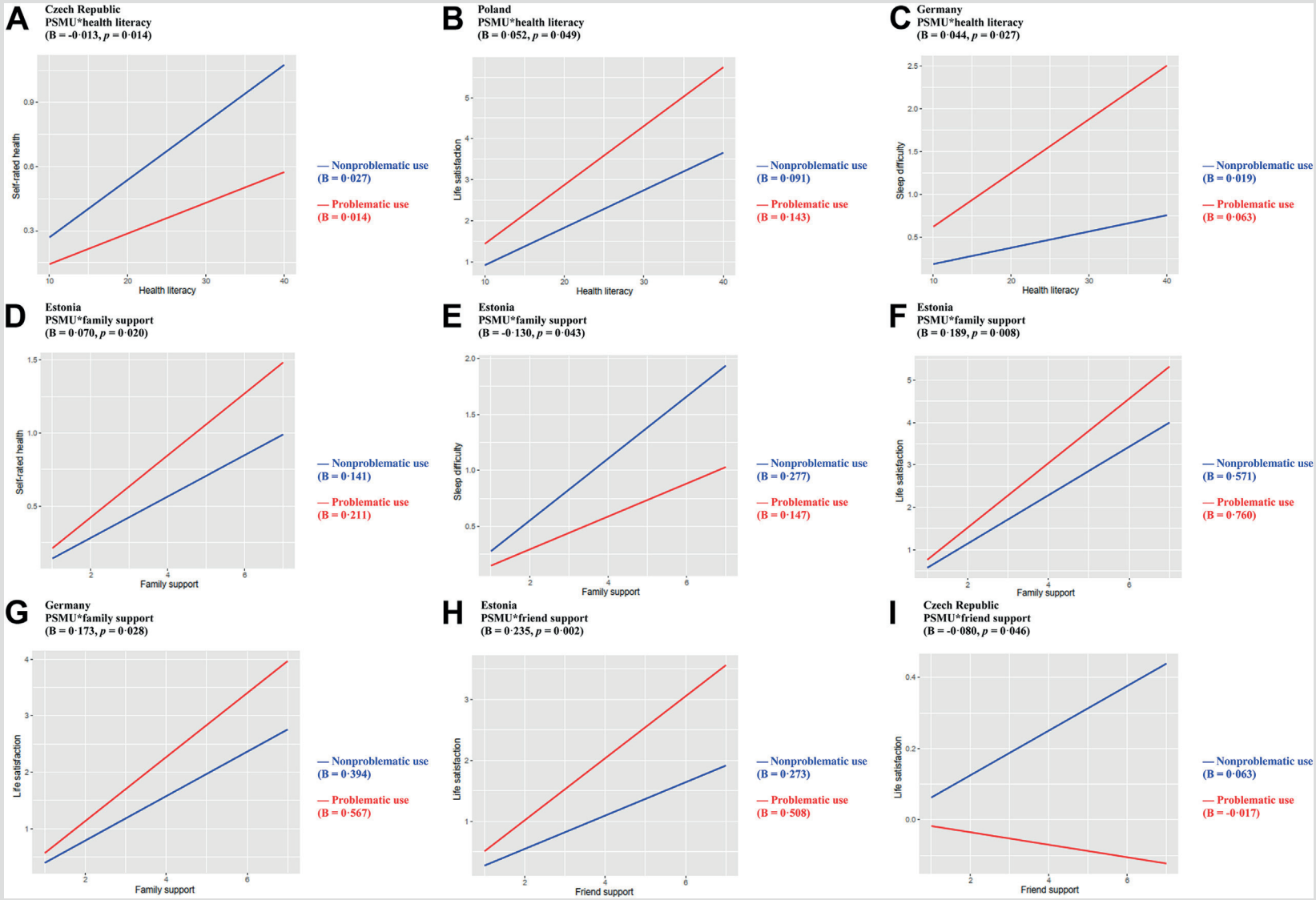
Table 4
The moderations of health literacy, family support, and friend support in the associations between PSMU and health outcomes; nationally

	Finland			Germany			Belgium			Estonia			Czech Republic			Poland		
	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*
Models: Health literacy as the moderator, Self-rated health as the outcome																		
HL	0.035	0.003	< .0001***	0.017	0.003	< .0001***	0.030	0.003	< .0001***	0.031	0.003	< .0001***	0.027	0.001	< .0001***	0.029	0.003	< .0001***
PSMU	−0.556	0.231	.016 *	0.251	0.279	.37	−0.627	0.311	.044*	−0.695	0.281	.014*	0.212	0.149	.15	−0.537	0.275	.051
PSMU * HL	0.011	0.007	.12	−0.014	0.010	.15	0.015	0.010	.15	0.018	0.010	.056	−0.013	0.005	.014*	0.012	0.009	.20
			$R^2 = 0.130$			$R^2 = 0.047$			$R^2 = 0.101$			$R^2 = 0.085$			$R^2 = 0.084$			$R^2 = 0.083$
			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$
Models: Health literacy as the moderator, Life satisfaction as the outcome																		
HL	0.094	0.007	< .0001***	0.049	0.007	< .0001***	0.053	0.006	< .0001***	0.082	0.007	< .0001***	0.059	0.004	< .0001***	0.091	0.008	< .0001***
PSMU	−1.536	0.572	.007**	−1.057	0.703	.13	−0.854	0.656	.19	−1.982	0.709	.005**	−0.761	0.394	.054	−2.256	0.796	.005**
PSMU * HL	0.033	0.018	.060	0.020	0.024	.41	0.013	0.022	.56	0.041	0.024	.089	0.004	0.013	.74	0.052	0.026	.049*
			$R^2 = 0.163$			$R^2 = 0.072$			$R^2 = 0.091$			$R^2 = 0.130$			$R^2 = 0.091$			$R^2 = 0.107$
			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$
Models: Health literacy as the moderator, Sleep difficulty as the outcome																		
HL	0.037	0.005	< .0001***	0.019	0.005	.0004***	0.025	0.007	.0003***	0.042	0.006	< .0001***	0.026	0.003	< .0001***	0.042	0.006	< .0001***
PSMU	−1.327	0.450	.003**	−1.825	0.567	.0013**	−1.746	0.739	.018*	−0.938	0.601	.12	−0.249	0.346	.47	−0.422	0.636	.51
PSMU * HL	0.022	0.014	.11	0.044	0.020	.027*	0.044	0.025	.075	0.005	0.021	.81	−0.010	0.012	.39	−0.007	0.021	.75
			$R^2 = 0.090$			$R^2 = 0.040$			$R^2 = 0.028$			$R^2 = 0.058$			$R^2 = 0.043$			$R^2 = 0.048$
			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.002$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
Models: Family support as the moderator, Self-rated health as the outcome																		
Family	0.101	0.010	< .0001***	0.101	0.009	< .0001***	0.072	0.010	< .0001***	0.141	0.009	< .0001***	0.019	0.004	< .0001***	0.093	0.007	< .0001***
PSMU	−0.247	0.150	.10	−0.301	0.180	.094	−0.226	0.171	.19	−0.471	0.166	.005**	−0.261	0.079	< .001***	−0.289	0.117	.014*
PSMU * Family	0.011	0.027	.69	0.039	0.032	.23	0.007	0.032	.83	0.070	0.030	.020*	0.020	0.016	.204	0.026	0.023	.26
			$R^2 = 0.081$			$R^2 = 0.079$			$R^2 = 0.077$			$R^2 = 0.119$			$R^2 = 0.028$			$R^2 = 0.089$
			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
Models: Family support as the moderator, Life satisfaction as the outcome																		
Family	0.394	0.025	< .0001***	0.394	0.021	< .0001***	0.299	0.019	< .0001***	0.571	0.022	< .0001***	0.118	0.010	< .0001***	0.513	0.020	< .0001***
PSMU	−0.128	0.362	.72	−1.260	0.437	.004**	−0.270	0.351	.44	−1.527	0.390	< .0001***	−0.870	0.207	< .0001***	−0.620	0.319	.052
PSMU * Family	−0.055	0.065	.40	0.173	0.079	.028*	−0.025	0.065	.70	0.189	0.071	.008**	0.054	0.041	.19	0.018	0.062	.773
			$R^2 = 0.169$			$R^2 = 0.175$			$R^2 = 0.162$			$R^2 = 0.277$			$R^2 = 0.067$			$R^2 = 0.223$
			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.002$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
Models: Family support as the moderator, Sleep difficulty as the outcome																		
Family	0.159	0.020	< .0001***	0.170	0.018	< .0001***	0.140	0.022	< .0001***	0.277	0.019	< .0001***	0.055	0.008	< .0001***	0.190	0.017	< .0001***
PSMU	−0.827	0.284	.004**	−0.597	0.359	.097	0.244	0.401	.54	−0.006	0.353	.99	−0.365	0.178	.040*	−0.691	0.267	.010**
PSMU * Family	0.049	0.051	.34	0.025	0.065	.70	−0.123	0.074	.095	−0.130	0.064	.043*	−0.036	0.035	.31	0.026	0.052	.62
			$R^2 = 0.093$			$R^2 = 0.062$			$R^2 = 0.035$			$R^2 = 0.101$			$R^2 = 0.038$			$R^2 = 0.072$
			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
Models: Friend support as the moderator, Self-rated health as the outcome																		
Friend	0.086	0.010	< .0001***	0.056	0.009	< .0001***	0.079	0.010	< .0001***	0.073	0.009	< .0001***	0.008	0.004	.048*	0.067	0.007	< .0001***
PSMU	−0.286	0.171	.093	−0.409	0.193	.034*	−0.143	0.194	.46	−0.276	0.166	.097	−0.237	0.075	.002**	−0.262	0.108	.016*
PSMU * Friend	0.007	0.030	.80	0.056	0.035	.117	−0.015	0.035	.66	0.019	0.031	.54	0.015	0.015	.33	0.015	0.024	.53
			$R^2 = 0.064$			$R^2 = 0.043$			$R^2 = 0.080$			$R^2 = 0.056$			$R^2 = 0.024$			$R^2 = 0.065$
			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
Models: Friend support as the moderator, Life satisfaction as the outcome																		
Friend	0.263	0.026	< .0001***	0.249	0.023	< .0001***	0.169	0.020	< .0001***	0.273	0.022	< .0001***	0.063	0.010	< .0001***	0.343	0.021	< .0001***
PSMU	−0.026	0.418	.95	−1.007	0.482	.038*	−1.106	0.413	.007**	−1.981	0.413	<.0001***	−0.328	0.197	.096	−0.455	0.306	.14
PSMU * Friend	−0.109	0.073	.13	0.101	0.088	.25	0.103	0.073	.159	0.235	0.077	.002**	−0.080	0.040	.046*	−0.066	0.067	.32
			$R^2 = 0.099$			$R^2 = 0.094$			$R^2 = 0.097$			$R^2 = 0.132$			$R^2 = 0.049$			$R^2 = 0.132$
			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.002$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$
Models: Friend support as the moderator, Sleep difficulty as the outcome																		
Friend	0.084	0.020	< .0001***	0.100	0.019	< .0001***	0.092	0.023	< .0001***	0.115	0.018	< .0001***	0.028	0.009	.002**	0.122	0.017	<.0001***
PSMU	−1.161	0.321	.0003***	−0.897	0.382	.019*	−0.040	0.459	.93	−1.156	0.349	<.001***	−0.417	0.169	.014*	-0.740	0.245	.003**
PSMU * Friend	0.090	0.056	.11	0.078	0.070	.264	−0.076	0.082	.35	0.065	0.065	.32	−0.030	0.034	.39	0.029	0.053	.59
			$R^2 = 0.069$			$R^2 = 0.038$			$R^2 = 0.025$			$R^2 = 0.054$			$R^2 = 0.032$			$R^2 = 0.049$
			$\Delta R^2 = 0.001$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$			$\Delta R^2 = 0.000$

(*continued on next page*)

Table 4
Continued

	Finland			Germany			Belgium			Estonia			Czech Republic			Poland		
	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*	Coeff	SE	*P*



Regression formula (e.g., in the PSMU group, the estimated effect of family support on self-rated health is $B_{\text{family support}} + B_{\text{PSMU*family support}} = 0.141 + 0.070 = 0.211$ in Estonia).
Controlled for gender, age, and family affluence.
Graphic representations of the moderations.
HL = health literacy.

(B) and the explained variance in the outcomes (Tjur's R^2 and Adjusted R^2) were often small despite being statistically significant. This was most evident in the effect sizes and variation changes due to moderation effects (i.e., interaction terms and ΔR^2 values). This leaves room to question how far some of the results can be interpreted as practically meaningful. As regards the missing data, the CCA is known to be susceptible to bias, although this was taken into consideration by conducting the analyses also via imputation. Finally, the overall findings on negative effects should be balanced with the potential benefits of social media use, including opportunities for social connection [2].

The list of moderators in our study was not exclusive, and other variables may also play a role in the studied relationships (RQ1 and RQ2). For the future, we suggest research on the moderation provided by digital literacy given that digital literacy is not fully captured by the health literacy instrument. Furthermore, more research is needed to explain the moderations and their direction (e.g., the reasons why in some instances, adolescents in vulnerable situations were the persons who gained greater benefit from the resources, while, in some cases, the improvements in resources actually widened the disparities between groups). It is also important to consider that the interpretation of the moderations can go multiple ways. Hence, interpretation of the resources as moderator variables can significantly influence recommendations for policy-making and intervention. The role of the resources as moderator variables was based on the theoretical foundation applied and on previous literature. However, longitudinal research is needed to verify such an interpretation. Moreover, research is needed to explain the reasons behind the country-level differences. For such research, socio-ecological, life course, and multilevel approaches could be appropriate.

Finally, one should consider the benefits and risks of using simpler regression models to investigate the moderations (i.e., with one resource variable and one interaction term in a model). The selection of the regression models was based on consistency in the country-level analyses (i.e., between-country consistency at the analytical level), which became important in pooling and weighting the results for the random-effects models. Furthermore, the simpler models behaved more consistently, were easier to interpret, were less prone to overfitting, and took account of the shared underlying construct of the two social support variables (i.e., family support and friend support). The risks in using the simpler regression analyses included potentially biased results, as the simpler models may not account for possible confounding variables. Furthermore, accuracy may be reduced due to underfitting, and there is the possibility of missing out on important data.

In conclusion, this study found that higher health literacy, family support, and friend support have the potential to moderate the association between individual characteristics and PSMU and between PSMU and health outcomes. Altogether, our results indicate a need for both universal and targeted interventions, with efforts to ensure that the impact of the resources is proportionately greater among adolescents in vulnerable situations. The interventions should also consider the cross-national and regional differences indicated in our study.

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Supplementary Data

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III

PROBLEMATIC SITUATIONS RELATED TO SOCIAL MEDIA USE AND COMPETENCIES TO PREVENT THEM: RESULTS OF A DELPHI STUDY

by

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Problematic situations related to social media use and competencies to prevent them: results of a Delphi study

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A three-round Delphi method was used to study the problematic situations that adolescents may encounter when using the social media, and the competencies needed to address these situations. A panel of Finnish experts (*N* = 22) provided an open-ended list of problematic situations and competencies in 2020–2021. These were then evaluated and ranked according to their significance. The experts provided an information-rich list of both problematic situations and competencies. Finally, 16 problematic situations and 19 competencies were ranked in order of importance by the experts. The most important problematic situations were direct and indirect cyberbullying and sexual harassment. The most important competencies were the ability to act responsibly, knowing what kinds of activity are prohibited, and knowing whom to contact on exposure to cyberbullying or harassment. The findings can be used in developing policies, recommendations, and solutions aimed at counteracting the harmful effects of social media on wellbeing during adolescence.

Keywords Social media, Problematic situation, Competency, Health, Wellbeing, Adolescent, Delphi

Social media spaces encompass social networking sites such as Facebook and Instagram, and instant messaging applications such as WhatsApp and Snapchat. These can serve as important growth and developmental contexts for adolescents[1]. Furthermore, because the online world overlaps with the offline world, the online world may help adolescents to "navigate important developmental issues from their offline lives," including sexuality, identity, and health[2]. The social media provide a venue for connection, for identity expression and formulation, and for comparison with others and the establishment of social norms[3]. Among adolescents, social media use constitutes a prime activity for entertainment, information-seeking, and communication[4], with an international European Commission report indicating that young people between the ages of 10 and 18 spend up to 7.5 h online per day[5]. Furthermore, the EU Kids Online 2020 report indicates that 69% of persons aged 12–14 and 81% of persons aged 15–16 go online *several times each day* or *all the time*[6]. Consequently, ensuring a safe and secure social media environment for adolescents has been incorporated as a key component in the European strategy for a Better Internet for Kids (BIK+)[7] and in the EU Strategy on the Rights of the Child[8].

Although the social media contribute positively to adolescents' lives[3,9], adolescents are vulnerable to various problematic situations while navigating and experimenting with the social media[1,9,10]. This may be due to their susceptibility to peer pressure, and to having limited self-regulation skills, as well as other competencies that would prevent or deal with such situations[1,11,12]. In this paper, problematic social media situations encompass risky or threatening situations which may cause negative effects on adolescents' health and wellbeing. The competencies in question combine skills, knowledge, and awareness sufficient to prevent problematic situations arising from social media and to deal with problematic situations if they arise[13].

Previous studies have identified a range of problematic situations related to adolescents' social media use; these may be grouped as those with (1) *direct* or (2) *indirect* consequences on their health and wellbeing[2,6]. The situations with *direct* health consequences involve situations such as cyberbullying[14] and sexual harassment[15], both of which have been associated with lower life satisfaction[16], and psychosomatic problems such as depressive symptomatology[17,18]. Cyberbullying is also associated with a greater likelihood of self-harm and suicide[19,20]. According to EU Kids Online 2020, 14% of adolescents report being a victim, while 8% report having been a bully at least a few times. Furthermore, 23% report having been a victim of aggressive behavior, and 14% report having been aggressors themselves. As regards sexual messages, 22% mention having received sexual messages

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over the past year, with 17% having received unwanted sexual requests at least a few times, and 6% having sent sexual messages[6]. The convergence of different forms of bullying and sexual harassment increases the likelihood of even more negative health impacts, as compared to experiencing just one type of victimization[16]. There is the further possibility of being in contact with strangers over the social media, which may increase the likelihood of being subjected to sexual harassment[18].

The situations with *indirect* health and wellbeing consequences could include the exposure to and sharing of a variety of harmful and provocative materials[1,6]. These can include risky social media challenges[21], as well as images and other content associated with high-risk behavior. There is evidence that social media content discussing risk behaviors (such as substance misuse) can potentially support beneficial attitudes regarding these behaviors[22]. Furthermore, social media challenges and risky selfie behavior[23] may encourage the performance of dangerous acts (e.g., climbing a cliff or onto a train) by which adolescents may seek to foster their social identity. Risk-taking behavior may result from a general desire to satisfy risk-taking needs, but also from a desire to connect with deviant peers and communities, and to seek peer approval[1]. Adolescents' desire for peer approval may be strengthened by the neural sensitivity of the socio-emotional system, which enhances the anticipated reward value of risk behaviors that are likely to be seen by peers[24].

Harmful and provocative material includes the plethora of appearance-focused content on popular adolescent social media platforms[6,25]. Exposure to such content may lead to distorted images of reality, and these may in turn lead to objectifying self-concepts, impossible body standards, and lowered self-esteem, especially among girls[10,26]. Furthermore, the EU Kids Online 2020 report[6] indicates that harmful and provocative content includes false information, racial discrimination, and hate speech. These can easily spread through adolescent online social networks and cause anxiety and distress[27,28], contributing to victimization, polarization, discredited stereotyping, and deterioration of trust towards authorities[29]. In Europe, 8–17% of adolescents aged 12–16 report that they have faced harmful content online at least monthly[6]. The same report notes that "exposure to different types of harmful content is interrelated—i.e., if a child sees one type of content, it is more likely that the same child will also see other types of harmful content." Approximately 10% of adolescents mentioned having encountered content on how to commit suicide, how to physically harm or hurt oneself, experiences of taking drugs, and ways to be thinner. In addition, 17% had encountered hate messages attacking particular groups or individuals[6].

Through social media, adolescents are also confronted with advertising that could have harmful effects on their health and behavior[30]. The social media allow marketers to adapt their messages to reach millions of adolescents, via targeted ads based on content that adolescents have previously viewed or posted on their profiles[31]. Furthermore, the social media have broadened the types of products adolescents are now exposed to. For example, major alcohol brands maintain a strong presence in popular adolescent social media platforms such as TikTok[32], and could thus impact on adolescents' health through endorsing alcohol consumption.

Other possible indirect effects on adolescents' health and wellbeing derive from privacy issues. The content that adolescents choose to share on any social media platform becomes to some degree public, and removal of such content can be difficult or impossible[33]. Furthermore, research has demonstrated that adolescent privacy practices vary significantly, and that even adolescents who understand how to manage privacy settings may choose not to do so[6,33]

The problematic situations related to adolescent social media use are diverse, as are the competencies for preventing and resolving such situations. Previous studies have identified an array of social media-related competencies, which include the self-regulatory skills needed to limit one's time on the social media and develop healthy usage patterns[34], together with the skills to maintain one's privacy[33], protect oneself from inappropriate material[34], and limit one's online disclosure of information[35]. Attention has been drawn to adolescents' need for cooperative conflict-resolution, ethical skills, and empathy[36,37]. There has also been an emphasis on general media literacy skills (e.g., to protect oneself from mis- and disinformation)[37], and health literacy[38], plus the abilities to talk about problematic social media situations with trusted adults, and to seek help if needed[39]. Many of the competencies mentioned above could help in addressing problematic situations in the social media from the perspective of both perpetrators and victims. For example, conflict-resolution skills and empathy have been shown effective against cyberbullying[36].

Problematic situations can have long-term negative effects on adolescents' development, wellbeing, and health. However, relatively little research has been conducted on problematic situations related to adolescents' social media use and their competencies in addressing these situations. One general conclusion from studies on problematic situations relating to the social media (regarding e.g., school interventions) has been that there is a need for a (possibly gradually achieved) expert consensus on (1) the most important problematic situations bound up with adolescents' social media use, and (2) the kinds of competencies that will be most effective in preventing such situations[34,37]. Such research is essential if one is to develop policies, recommendations, and solutions that could target and prevent the harmful effects of the social media on the wellbeing of adolescents[10]. With this aim in view, the research questions for the present study were:

RQ1. What are the most important problematic situations that adolescents may encounter when they use the social media?
RQ2. What kinds of competencies do adolescents need to prevent problematic situations arising from the social media, and to deal with problematic situations if they arise?

Material and methods

The Delphi method was utilized for this study. The Delphi method combines quantitative and qualitative processes that draw anonymously on selected experts' opinions, and it aims to obtain a group consensus on a phenomenon[40,41]. The Delphi method has been deemed appropriate where scientific knowledge on the topic

studied is scarce[40], and it has been seen as useful when qualitative methods (such as face-to-face data collection) are impractical[41]. In this study, a three-round survey process was employed over a period of seven weeks[42]. Before conducting the Delphi study, the research team developed the questions internally and conducted pilot testing with selected experts. The aim of the pilot testing was to ensure the usability and comprehensibility of the questions for external participants. This was done by ensuring that the questions in each round were suitable and understandable, and thus appropriate for the study purposes[43]. Pilot testing was carried out prior to each round of the Delphi study.

Participants and procedure

In previous Delphi studies, the sample sizes have varied from three to several hundred[44]; however, the majority of Delphi panels consist of under fifty experts[45]. In the present study, previous Delphi studies on health promotion were used as a guideline for selecting an appropriate number of participants, in conjunction with the guidelines provided by Okoli and Pawlowski[46]. Thus, the present study was based on the subjective opinions of *22 pre-selected experts*.

Because a Delphi study is a group-decision mechanism requiring experts with a deep understanding of the issues[46], the present study employed purposeful sampling to identify "information-rich participants." Specifically, we employed maximum variation sampling[47] to gather diverse expert viewpoints on the phenomenon in question and thus gain a meaningful consensus on the topic[45]. The sample recruitment process was based on the Knowledge Resource Nomination Worksheet (KRNW)[46]. Following KRNW—which is designed to help categorize experts before identifying them—the relevant knowledge areas, skills, practitioners, academics, and organizations were initially identified. The worksheet was then populated with the names of relevant individuals, pinpointed either through organizational websites or expert publications. Sub-lists were created for each area of expertise, and experts were ranked and categorized appropriately, leading to the formation of a panel structure. The experts were selected in order of their ranking, profession, geographical position, and area of expertise to achieve a versatile panel that could provide multiple viewpoints on the subject matter. Complementary expertise was pursued by selecting many different kinds of specialists, hence, not merely (for example) researchers. The chosen experts were then invited, with a request to propose an alternative participant in case they were unable to participate.

On the basis of the KRNW, the experts chosen for this study were researchers from the fields of media education, educational science, psychology, health education, and information research, with inclusion also of teachers and principals working in primary and secondary education and in high schools. There were also other proven experts from the fields of the media, plus professionals in the social and healthcare fields, such as psychologists, child psychiatrists, medical doctors, and youth workers. Data collection was implemented via an electronic questionnaire sent to the selected participants by email. Anonymity is a key component of a Delphi study, with the aim of freely facilitating views on the topic; thus, the email was sent to the selected persons with no possibility to trace an answer to a particular individual. The participants did not know the content of other responses, nor the personality of other respondents. The collation of the responses was undertaken by the research group. The Delphi was performed in Finnish, which was the native language of the experts.

The first round of the Delphi study

The goal in the first round was to encourage experts to freely produce ideas on the research phenomenon, and to generate questionnaire items for the second round[48]. The first round consisted of two open-ended questionnaires in which experts were asked to list (1) problematic situations that adolescents may encounter when they use the social media, and (2) competencies that adolescents need to prevent and deal with problematic situations in the social media. Five members of the research team carefully considered the answers that the experts in the first round had provided. The qualitatively differing problematic situations and competencies were identified and listed (separately), and the overlaps from the responses were removed. While reading the expert responses, the members of the research team acted as critical friends for each other. This approach can be described as a critical dialogue between researchers, in which their understandings are shared and mutual critical feedback is given[49]. The various viewpoints of the team members were thus positioned as resources for challenging and expanding the interpretations[49]. The responses were (re)formulated as statements for the second round, ensuring loyalty to the original responses. Thus, all qualitatively differing problematic situations and competencies were identified and listed.

The second round

For the second round, an online questionnaire was created containing a collection of items mentioned by participants. The problematic situations and competencies were listed separately. Within each list, the items were presented in random order. In building the items, the wording used by participants was followed as closely as possible[48]. The experts were asked to rate the importance of each item on a 7-point Likert scale using the questionnaire. The scale for the problematic situations and the scale for the competencies both ranged from 1 = *not at all important* to 7 = *very important*. The experts' responses were quantitatively analyzed based on previous Delphi literature[48,50]. To determine the most important items, the modes, medians, and means were computed. In addition, standard deviations and Z-scores (standardized scores with sample mean = 0, standard deviation = 1) were calculated. Agreement percentages were also inspected. Firstly, calculation was made of the number of agreeing pairs of respondents divided by the number of all possible pairs of respondents in the dataset. Additionally, the proportion of respondents who rated an item as among the top x most important items (abbreviated henceforth as agree % ≥ x) was determined for different values of x. The most important items were listed and utilized to create a new questionnaire for the final round (i.e., round 3).

The third round

In the third round, the experts were asked to select and rank the eight most important problematic situations and competencies separately. Items that did not make the top-eight list were given a value of 0. The ranking was applied to the items that emerged as the most important in the second round, based on the quantitative analysis. The sum scores, the mean, and the agreement percentages of the experts' responses were analyzed to determine the most important problematic situations and competencies according to the experts' opinion.

Ethical approval

The Ethical Committee of the University of Jyväskylä was consulted and concluded that applying for ethical approval was not necessary due to the use of anonymous procedures. All three rounds of the Delphi study contained questions regarding willingness to participate. At this point, the participants approved the privacy notice compliant with the European Union's General Data Protection Regulation (GDPR)[51]. All research procedures followed the responsible conduct of research guidelines and regulations of the Finnish National Board on Research Integrity (TENK)[52]. Informed consent was obtained from all participants.

Results

The first round

The panel for the first round consisted of 19 experts. The two open-ended questionnaires gave a list of 125 problematic situations that adolescents may encounter related to social media use, and 82 competencies required to address problematic situations. After careful consideration of the qualitative similarities in the content, 29 problematic situations (Table 1) and 24 competencies (Table 2) were formulated.

The second round

Twenty-two experts participated in the second round. The problematic situations and the skills were listed separately from each other, each in random order, to avoid influencing the results. Based on the quantitative analyses, the experts considered most of the 29 problematic situations and 24 competencies to be important (i.e., having medians ≥ 5, modes ≥ 5, with one exception; Tables 1, 2). For the subsequent (third) round, the cut-off criteria were set at a median and mode of ≥ 6, a mean of ≥ 5, and a Z-score ≥ -1. The decision was based on the need to have a sufficient number of high-importance items for further evaluation and selection in the third round, but also to gradually move towards identifying the most important problematic situations and competencies among adolescents (i.e., to narrow down the responses)[43]. According to statistical assessment, a more lenient cut-off would have yielded too many items, whereas a more stringent cut-off would have overly constrained the pool of items. Nevertheless, we have listed all the items and their corresponding values in Tables 1 and 2, recognizing that no generally accepted cut-off criteria exist in the literature[53]. The selected cut-off yielded 16 problematic situations and 19 skills (indicated by bold text in Tables 1, 2).

The third round

In the final round, 17 experts participated in the questionnaire. In this round, the experts were asked to identify and then rank the eight most important problematic situations and competencies among the 16 problematic situations and 19 competencies that remained from the second round. The most important item received eight points from the participants and the eighth most important received one point, yielding a theoretical maximum of 136 if all of the participants had chosen the same item as the most important. The findings (Tables 3, 4) indicate that the responses varied across the items, but that all of the items were mentioned in the lists of the eight most important items provided by the respondents overall.

In order to identify the most important problematic situations and competencies, sum scores were calculated. As regards the problematic situations, *exposure to direct cyberbullying* received a sum score of 102, while *exposure to indirect cyberbullying* received a sum score of 74. As regards the most important competencies, *the ability to act responsibly and without offending others* received a sum score of 80, while *knowing what kinds of activity are prohibited* received a sum score of 72.

Discussion

The study investigated experts' opinions on (1) the most important problematic situations that adolescents may encounter when they use the social media, and (2) the competencies needed by adolescents in addressing these situations. According to the findings, the three most important problematic situations were *exposure to direct cyberbullying* (i.e., vicious behavior, public humiliation), *exposure to indirect cyberbullying* (i.e., being excluded from digital communities), and *exposure to sexual harassment and molestation*. The three most important competencies were *the ability to act responsibly in social media*, *knowing what kinds of activity are prohibited* (e.g., identity theft, dissemination of false information, defamation), and *knowing whom to contact when exposed to cyberbullying, harassment, or sexual harassment*. Despite some differences, the competencies showed a good match with the problematic situations. In addition, some of the competencies identified could be seen as transversal competencies, relevant to many problematic situations (e.g., *the ability to assess one's own behavior and that of others on social media*, *the ability to identify problematic social media situations in one's daily life*, and *knowing one's own rights*).

Our findings are in line with previous studies investigating perspectives by experts[10,11] and adolescents[2,35] regarding problematic situations in the social media. These have indicated cyberbullying and sexual harassment as particularly problematic. This may be due to their direct negative consequences on the victim's wellbeing, but further research is needed on this aspect. It is worth noting that (direct and indirect) cyberbullying may

Problematic situation	Median	Mean	Mode	Std	Agreement % ≥ 5	Agreement % ≥ 6	Agreement % = 7	Z-Score
Exposure to direct cyberbullying (vicious behavior, anonymous bullying, public humiliation, name-calling)	7	6.50	7	0.91	95	95	64	1.98
Exposure to indirect cyberbullying (becoming excluded from digital communities, online gossip)	6	6.14	7	0.89	95	77	41	1.26
Incapacity to manage time spent on social media	6	6.00	7	1.20	82	68	50	0.99
Lack of knowledge and skills to critically address social media content	6	6.00	7	1.11	91	73	41	0.99
Exposure to pressures regarding appearance; an appearance-oriented world view	6	6.00	7	0.98	95	64	41	0.99
Excessive time spent on social media, and increased screen time	6	5.95	7	1.33	86	73	45	0.90
Exposure to racism	6	5.91	7	1.11	86	64	41	0.80
Reduced quality/quantity of sleep through the use of social media	6	5.86	7	1.36	86	64	45	0.71
Addiction to social media use (i.e., compulsive and uncontrolled use)	6	5.86	7	1.17	91	59	41	0.71
The need to be constantly available in order not to be excluded (fear of missing out)	6	5.59	7	1.30	82	55	32	0.17
Exposure to online scams	6	5.36	7	1.65	68	55	36	−0.28
Exposure to sexual harassment and molestation	6	5.86	6	0.99	86	73	27	0.71
The child or adolescent behaves offensively on social media and does not understand the emotional content of messages (low emotional skills)	6	5.82	6	1.05	82	73	27	0.62
Sharing without permission the private and sensitive information or files of other people	6	5.82	6	0.91	91	68	23	0.62
Sharing of one's own personal, private, and sensitive information or files	6	5.62	6	1.02	90	57	19	0.23
Exposure to negative behavior/provocative material shared by others (e.g., images or video footage of violence, at-risk situations, intoxicants, or gambling)	6	5.10	6	1.55	67	52	14	−0.81
Social media having an unfavorable effect on concentration and attention when studying	6	5.82	5	0.96	95	55	32	0.62
Exposure to a distorted image of reality	6	5.68	5	1.17	86	55	32	0.35
Exposure to social media challenges that are harmful or dangerous to health	5	4.95	6	1.25	64	36	9	−1.09
Valuing others on the basis of social media profiles (e.g., number of followers or likes)	5	5.36	5	1.29	77	45	23	−0.28
Inadvertent or intentional dissemination of false information (e.g., fake news and conspiracy theories)	5	5.27	5	1.28	77	36	23	−0.46
Exposure to distorted or false information (e.g., fake news, conspiracy theories)	5	5.10	5	1.30	71	38	14	−0.81
Seeking out material that could provoke negative behavior by the person encountering it (e.g., porn sites or violent sites; joining groups that encourage risky behavior)	5	5.09	5	1.54	77	41	18	−0.82
Exposure to poor role models, and their glorification	5	5.05	5	1.50	73	36	18	−0.91
Exposure to commercial marketing (tempting to buy something that a young person cannot afford, such as in-game purchases)	5	5.00	5	1.35	77	32	14	−1.00
Exposure to targeted influence (e.g., the social media front page is modified according to the person's previously searched material)	5	4.82	5	1.44	68	32	9	−1.36
Exposure to an excessive information flood	5	4.64	5	1.50	64	32	5	−1.72
Poorly protected social media profiles	5	4.57	5	1.54	57	29	10	−1.85
Exposure to identity theft	5	4.86	4	1.42	55	36	14	−1.27

Table 1. Problematic situations that adolescents may encounter when they use social media, as identified by an expert panel.

last longer than bullying in traditional environments (e.g., in schools), due to a lack of immediate indications of bullying, and to the adolescent not mentioning bullying to an adult[54] Furthermore, Slonje et al.[55] have noted that cyberbullying can be anonymous, but that the potential audience can be larger; also, that cyberbullying is not tied to any time or place and may take place in usually safe environments (e.g., within the home), meaning that there is no "safe haven."

In cases of bullying or sexual harassment, or other concerning situations such as racism (which was also ranked fairly high by the experts of this study), it is important that adolescents should not face these experiences on their own. According to the EU Kids Online study[6], almost half of adolescents had either talked to their parents (40%) or to their peers of the same age (50%) after negative online experiences; however, one in five had not talked to anyone. Many abilities are important in terms of being able to contact someone, including knowing (1) *what kinds of activity are prohibited*, or in other ways unacceptable, (2) *whom to contact when exposed to*, for

Competency	Median	Mean	Mode	Std	Agreement % ≥ 5	Agreement % ≥ 6	Agreement % = 7	Z-Score
Knowing whom to contact when exposed to cyberbullying, harassment, or sexual harassment	7	6.73	7	0.55	100	95	77	1.33
Ability to act responsibly and without offending others on social media	7	6.59	7	0.80	95	91	73	1.04
Ability to act empathetically and with respect for others on social media	7	6.59	7	0.80	95	91	73	1.04
Ability to assess the trustworthiness of a previously unknown online friend	7	6.55	7	0.74	95	95	64	0.94
Knowing what kinds of activity are prohibited (identity theft, sexual harassment, dissemination of information, defamation)	7	6.55	7	0.91	91	91	73	0.94
Ability to ask for help from a trusted adult if necessary	7	6.50	7	0.74	100	86	64	0.84
Ability to assess what contents are suitable for publication or sharing	7	6.50	7	0.80	95	91	64	0.84
Ability to protect personal privacy (e.g., passwords and profile privacy settings)	7	6.50	7	0.74	100	86	64	0.84
Ability to manage time spent on social media	7	6.41	7	0.96	95	91	59	0.65
Ability to assess the trustworthiness of published information	7	6.41	7	0.73	100	86	55	0.65
Knowing where to report inappropriate material	7	6.36	7	0.85	95	86	55	0.55
Ability to identify, process, express, and regulate emotions on social media	6	6.32	7	0.78	100	82	50	0.46
Ability to compare information published in different data sources	6	6.14	7	0.83	100	73	41	0.07
Having knowledge and skills on how to apply security practices to protect privacy (one's own and that of others)	6	5.86	7	1.25	86	59	45	−0.51
Knowing one's own rights (e.g., right to information, privacy, and freedom of expression)	6	6.09	6	0.87	95	77	36	−0.03
Ability to explain how social media affect one's self-image and self-esteem	6	5.95	6	1.13	95	77	32	−0.32
Ability to evaluate the credibility of social media posts; knowing that information given on social media is not the whole truth about the publisher's life	6	5.95	6	0.90	95	68	32	−0.32
Ability to identify problematic social media situations in one's daily life	6	5.73	6	1.16	91	68	23	−0.81
Ability to assess one's own behavior and that of others on social media	6	5.73	6	0.83	91	68	14	−0.81
Ability to explain how social media use can affect one's health	6	5.55	6	1.10	82	59	18	−1.19
Ability to assess the distribution and persistence of one's own publications (digital footprint)	6	5.77	5	0.97	91	59	27	−0.71
Knowing matters related to the privacy, publicity, and ownership of apps and sites	5	5.27	6	1.35	77	50	18	−1.78
Ability to give examples of possible social media problems	5	5.24	5	0.94	81	29	14	−1.85
Ability to explain the means of influencing used by commercial operators on social media (marketing, influencing)	5	5.23	5	0.97	77	32	14	−1.87

Table 2. Competencies required to prevent/deal with problematic social media situations, as identified by an expert panel.

instance, *cyberbullying, harassment, or sexual harassment*, and (3) *where to report inappropriate material*. The first two competencies were ranked as the second and third most important competencies by the experts in our study. However, the proportions related to not receiving help from parents (36%), friends (55%), or a teacher (65%) after being bothered by something on the internet[6] indicate clear deficiencies in social support. The experts also highlighted the importance of having the skills to *assess the trustworthiness of the previously unknown online friend* and to *assess what contents are suitable for publication or sharing*. These are critical in hindering exposure not just to harassment, but also to other kinds of security risks, such as privacy violations[56], and are clearly linked to the problematic situation of *sharing one's own personal, private, and sensitive information or files*. Competencies related to privacy issues can be deemed particularly important in situations where adolescents share private or sensitive information (their own or that of others), or are exposed to online scams[12]. However, based on the EU Kids Online 2020 report, every fifth adolescent has difficulties in changing their privacy settings[6].

The expert panel rated social media-induced *pressures regarding appearance* as a significant problematic situation. This concern has also been raised by previous literature in which it has been noted that popular social media platforms contain an abundance of appearance-focused content promoting athletic and muscular ideals for males, and thin and curvaceous ideals for females[57]. This may lead to unrealistic standards of beauty and physical appearance, objectifying self-concepts, and impossible body standards among adolescents[10,26]. The visual nature of the social media, combined with quantifiable peer feedback (e.g., likes, comments) and the public exposure entailed, may exacerbate appearance pressure and appearance-focused social comparison in the developmentally sensitive period of adolescence[58]. Thus, experts in this study highlighted the importance

Problematic situations	Sum	Mean	Agreement % = 8	Agreement % ≥ 4	Agreement % ≥ 1
Exposure to direct cyberbullying (vicious behavior, anonymous bullying, public humiliation, name-calling)	102	6.00	29	77	100
Exposure to indirect cyberbullying (becoming excluded from digital communities, online gossip)	74	4.35	12	59	82
Exposure to sexual harassment and molestation	69	4.06	29	53	82
Exposure to pressures regarding appearance; an appearance-oriented world view	44	2.59	6	35	59
Exposure to negative behavior/provocative material shared by others (e.g., images or video footage of violence, at-risk situations, intoxicants, or gambling)	44	2.59	0	41	65
Exposure to racism	36	2.12	0	35	35
Lack of knowledge and skills to critically address social media content	36	2.12	12	29	53
Reduced quality/quantity of sleep through the use of social media	33	1.94	0	35	47
Addiction to social media use (i.e., compulsive and uncontrolled use)	32	1.88	6	35	41
The child or adolescent behaves offensively on social media and does not understand the emotional content of messages (low emotional skills)	32	1.88	0	24	47
Incapacity to manage time spent on social media	25	1.47	0	18	47
The need to be constantly available in order not to be excluded (fear of missing out)	22	1.29	6	12	35
Sharing of one's own personal, private, and sensitive information or files	21	1.24	0	12	35
Exposure to online scams	16	0.94	0	12	24
Excessive time spent on social media and increased screen time	14	0.82	0	12	18
Sharing without permission the private and sensitive information or files of other people	12	0.71	0	12	30

Table 3. Problematic situations that adolescents may encounter when they use social media; ranked in order of importance by an expert panel. Agreement % = 8 is the proportion of respondents who gave the item score a rating of 8. Agreement % ≥ 4 is the proportion of respondents who rated the item score among the top half of items. Agreement % ≥ 1 is the proportion of respondents who rated the item score among the top 8 items.

Competency	Sum	Mean	Agreement % = 8	Agreement % ≥ 4	Agreement % ≥ 1
Ability to act responsibly and without offending others on social media	80	4.71	18	71	77
Knowing what kinds of activity are prohibited (identity theft, sexual harassment, dissemination of information, defamation)	72	4.24	24	65	71
Knowing whom to contact when exposed to cyberbullying, harassment, or sexual harassment	58	3.41	6	47	77
Ability to ask for help from a trusted adult if necessary	46	2.71	12	41	53
Having knowledge and skills on how to apply security practices to protect privacy (one's own and that others)	40	2.35	6	35	47
Ability to act empathetically and with respect for others on social media	35	2.06	6	18	65
Ability to evaluate the credibility of social media posts; knowing that information given on social media is not the whole truth about the poster's life	35	2.06	6	18	59
Ability to protect personal privacy (e.g., passwords and profile privacy settings)	33	1.94	0	35	35
Ability to assess the trustworthiness of a previously unknown online friend	32	1.88	6	24	53
Ability to manage time spent on social media	27	1.59	6	18	47
Ability to assess the trustworthiness of published information	26	1.53	0	24	35
Knowing one's own rights (e.g., right to information, privacy, and freedom of expression)	26	1.53	0	24	29
Ability to assess what contents are suitable for publication or sharing	24	1.41	0	24	35
Ability to assess one's own behavior and that of others on social media	17	1.00	6	12	18
Ability to explain how social media affect one's self-image and self-esteem	16	0.94	6	12	18
Ability to identify problematic social media situations in one's daily life	16	0.94	0	12	29
Ability to identify, process, express, and regulate emotions on social media	15	0.88	0	12	24
Ability to compare information published in different data sources	13	0.76	0	12	24
Knowing where to report inappropriate material	1	0.06	0	0	6

Table 4. Competencies adolescents require to prevent/deal with problematic social media situations; ranked in order of importance by an expert panel. Agreement % = 8 is the proportion of respondents who gave the item score a rating of 8. Agreement % ≥ 4 is the proportion of respondents who rated the item score among the top half of the items. Agreement % ≥ 1 is the proportion of respondents who rated the item score among the top 8 items.

of providing adolescents with the machinery to *evaluate the credibility of social media posts,* and to *explain how social media affect one's self-image and self-esteem*.

Another important problematic situation in the views of the experts was *exposure to negative behavior/provocative material* (e.g., images or video footage of violence, at-risk situations, intoxicants). According to earlier models and theories, including the *Facebook Influence Model*[59] and the *Super-peer* theory[60], the social media context amplifies peer influence processes, which may lead to participation in and the publishing of risky behavior, with the hope of measurable validation (e.g., likes). Furthermore, the social media environment could potentially intensify the pursuit of sensation by presenting risky challenges as thrilling and enjoyable[1]. Although among some adolescents provocative material (such as violence) may induce excitement, in others it may cause anxiety, fear, and depressive feelings[61,62]. When exposed to such material, adolescents should be equipped with skills to evaluate the post's credibility, assess the publisher's behavior and reasoning behind the post, and know where to report the inappropriate material—competencies also deemed important by the expert panel.

According to our study, the most important problematic situations relate to adolescents having the role of an object (i.e., being a victim or "being exposed to" various problematic situations) rather than that of a perpetrator (involving, for example, offensive behavior, and the sharing of personal or sensitive files belonging to others), with the perpetrator's role being ranked at 10th or lower in order of importance. However, the competencies that emerged as high in the ranking covered not just the skills needed to deal with being treated as an object in social media communication (such as the abilities to identify what behavior is not right in the social media, and how to proceed if one is faced with such situations), but also the competencies to avoid such situations in the role of a communicator. The latter would involve the social media competencies covered by, for example, *the ability to act responsibly and without offending others*, *the ability to act empathetically and with respect for others*, and *the ability to assess one's own behavior and that of others.* This clearly underlines the dual role of adolescents in the social media. At the same time, it echoes discussions on "digital citizenship," going beyond the mere emphasis on how to be safe from digital risks, towards highlighting the role of "the rights and responsibilities of individuals and groups as communicators," encompassing also online communication[63]. The need in question is also highlighted by the declaration of the Council of Europe[64], which refers to "the ability to engage positively, critically and competently in the digital environment, drawing on the skills of effective communication and creation, to practice forms of social participation that are respectful of human rights and dignity through the responsible use of technology".

The socio-emotional skills (such as *the ability to act empathetically and with respect for others on social media*) and self-regulatory competencies (such as *the ability to manage time spent on social media*) that were ranked highly by the experts have been deemed important in previous studies (for socio-emotional skills, see[65], for self-regulatory competencies, see[34]). Overall, a large body of literature [e.g.,[66,67]] confirms that vicious online behavior (such as cyberbullying) can be explained by a lack of socio-emotional skills during adolescence. Cyber perpetrators have been shown to have low empathy in the affective domain, but also low cognitive empathy[66]. On the other hand, low social and emotional efficiency has also been linked to an increased likelihood of becoming a cybervictim[65]. It further appears to be the case that weak self-regulatory competencies among adolescents may lead to problematic use of social media[68], intensive use[69], and nighttime-specific use[70]. These notions are in line with the Delphi findings; several identified problematic situations had a link with either the time spent on the social media (e.g., excessive time spent on social media, and incapacity to manage that time), or how the time spent affected one's behavior (e.g., sleeping patterns, addictive use of social media, and the need to be constantly available to avoid exclusion). In Europe and Canada, almost every tenth adolescent can be seen as a problematic social media user[71]. Furthermore, the proportion of those with a heightened risk of developing such a behavioral pattern is even bigger. For instance in Finland, every third adolescent can be seen as belonging to a group with a heightened risk for problematic social media use[68]. Given the well-established literature showing the link between problematic use and unfavorable health and health behavior [e.g.,[68–70]], it is imperative that adolescents are provided with learning experiences that could improve their self-regulative competencies in the relevant online contexts[72].

Despite media interest in Finland during the last couple of years, the scores of the experts were too low to move *exposure to social media challenges that are harmful or dangerous to health* or *exposure to distorted or false information* (e.g., fake news, conspiracy theories) to the third Delphi round. Research is needed to understand these findings, given the possible severe consequences of risky behavior (as in being severely burned after a climb to the roof of a train). Moreover, mis- and disinformation is a problem that almost all people face in the social media, with possible danger to health. However, one particular problematic situation, namely *a lack of knowledge and skills to critically address social media content*, and several skills such as *the ability* to *assess the trustworthiness of published information*, and *the ability to compare information published in different data sources*, raised by the experts in this study, echo similar problems (plus the skills to handle them) raised elsewhere. In Europe, while 60% of adolescents report being able to assess the validity of online information, 40% do not[6]. However, recent PISA findings indicate an even worse situation, insofar as only 7% of the students were able to find the differences "between fact and opinion as applied to complex or abstract statements"[73]. Much work is needed to further the aim that "no child should be left behind in the digital age, especially not those already disadvantaged in other ways"[6].

The strengths of the study included a versatile profile of experts, identified via the guidelines of Okoli and Pawlowski[46]. Furthermore, the anonymity of the responses reduced the impact of dominant individuals and peer pressure to conform, thus allowing opinions to be considered in a non-adversarial manner[46]. In a Delphi study, the responses are weighted equally, so individual answers cannot shift the opinions of the group. Despite this, the current study has limitations which could open avenues for future research. For example, the study could be viewed as limited by the lack of clear methodological guidelines for the Delphi design. Furthermore, the arbitrary cut-off in the second round was due to there being no generally accepted criteria in the literature[53].

Note also that the time and place of participation were not controlled. The study was further limited by cultural and geographical factors, since it only involved Finnish experts. One can surmise that in other countries, there could be differences in expert views regarding the most important problematic situations encountered on the social media, as well as the competencies required to deal with them. It is therefore important to be cautious in generalizing the findings beyond Finland. One should also bear in mind that the experts' views were subjective; thus, it is possible that another Delphi panel with the same questions would come to different conclusions. Furthermore, the first round of the Delphi study carried the risk of biased interpretation, even if this was considered by the research team by carefully going through the expert answers, and serving as critical friends for each other[49].

Future studies could (1) test the effectiveness of interventions aimed at applying the identified skills to problematic situations, and (2) study adolescents' own views on the problematic situations and relevant competencies, with possibilities for contrasting these with the views of experts. Note also that different platforms may be differently associated with problematic situations; hence, a platform-specific approach would be beneficial, in parallel with differentiating between social media activities in general. However, as suggested by Smahel et al.[6], the degree to which children are exposed to online risks is often less than that feared by parents or claimed by the mass media. There is a need for a deeper understanding of which adolescents are most susceptible to online risks. Studies on these lines would be of great value in developing intervention programs, educational settings, and policies applicable to wellbeing in the digital world.

To conclude, online spaces, including the social media, form important contexts for the growth and development of adolescents, and increased time spent on social media has been linked to a higher likelihood of problematic situations[1]. Hence, developing the competencies to address such situations becomes crucial. This study can be viewed as identifying the most important problematic situations and related competencies, meaning that the results could be applied to intervention programs, the educational settings of professionals (such as teachers and social workers), the information given to parents, and political decision-making.

Data availability

The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request. The privacy notice compliant with the European Union's General Data Protection Regulation (GDPR)[51], approved by the participants via informed consent will be considered in data sharing.

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IV

SOCIAL MEDIA THREATS AND HEALTH AMONG ADOLESCENTS: EVIDENCE FROM THE HEALTH BEHAVIOUR IN SCHOOL-AGED CHILDREN STUDY

Lahti, H., Kokkonen, M., Hietajärvi, L., Lyyra, N., & Paakkari, L.

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Social media threats and health among adolescents: evidence from the health behaviour in school-aged children study

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Abstract

Background Social media are immensely popular among adolescents. Thus, concerns have been raised about the threats adolescents encounter on social media and the possible negative health consequences, such as depressive symptoms and anxiety. This study investigated the prevalence of nine social media threats: (1) cyberbullying, (2) sexual harassment, (3) racism, (4) unauthorized distribution of sensitive material, (5) phishing attempts, (6) misinformation, (7) the sale or distribution of drugs, (8) harmful or dangerous social media challenges, (9) content causing appearance pressures. The study also investigated how individual and social factors, problematic social media use (PSMU), and online communication with strangers are associated with social media threat exposure, as well as the association between social media threats and self-rated health, depressive feelings, and anxiety symptoms.

Methods and findings Nationally representative Health Behaviour in School-aged Children (HBSC) data from Finland were obtained from 2288 respondents aged 11, 13, and 15 years. Fixed effects regression models were applied. The most common threat, encountered daily and weekly, was misinformation. Regression models showed that individual and social factors, PSMU, and online communication with strangers explained adolescent exposure to social media threats in differing ways. Furthermore, certain factors (e.g., emotional intelligence, family support) were associated with encountering social media threats less frequently, whereas other factors (e.g., PSMU, online communication with strangers) were associated with more frequent encounters. Daily and weekly exposure to social media threats was systematically associated with poor self-rated health, frequent depressive feelings, and anxiety symptoms.

Conclusions Our study highlights the need for intervention and health promotion efforts to mitigate adolescent exposure to social media threats and ensuing negative health consequences.

Keywords Social media threat, Adolescent, Health, Depressive feelings, Anxiety, Cyberbullying, Sexual harassment, Racism, Misinformation, Social media challenges

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Background

During the past decade, the social media, including social networking sites and instant messengers, have gained immense popularity among adolescents [1]. The international study on Health Behaviour in School-aged Children [2] found that 41% of 15-year-olds used social media throughout the day, almost all the time. Moreover, research conducted on US adolescents aged 13–17 found that the number of young people reporting constant online presence almost doubled from 24% in 2015 to 45% in 2018 [3, 4]. Although social media may benefit adolescents by increasing social connectedness and fostering social self-identity [5], concerns have been raised about the threats encountered by young people on social media [6–8], and the ensuing unfavourable health consequences such as depressive symptoms and anxiety [9, 10]. Social media threats include a broad range of risky and harmful situations facilitated by the social media [11] such as cyberbullying [12], online discrimination (e.g., sexual harassment, racial discrimination) [9, 13], and misinformation [14].

There appear to be two notable reasons for the vulnerability of adolescents to social media threats. Firstly, adolescence represents a window of developmental sensitivity due to profound social, biological, and psychological development [15]. It is a widely held view that substantial changes in the adolescent social brain make adolescence a sensitive period for social interaction (involving, for example, more approaches to peers than among children aged < 10) [16], peer influence [17, 18], and self-perception [19]. Adolescence also represents a time of heightened susceptibility to risk-taking behaviour [20] and vulnerability [6]. In today's world, the social media facilitate all these developmental processes [5]. Secondly, social media are particularly popular among young people. Adolescents report an increasing use of social media to socialize, share their lives, learn about their peers' lives, explore their interests, search for information, and entertain themselves [21, 22]. This has led to many adolescent offline problems transferring to online contexts, and to the emergence of new threats. These are bound up with several social media features, notably the flow of rapidly spreading information [23] and the broad audience reach [14]. Ensuring adolescent safety on these platforms has therefore been incorporated as a key component of the European Strategy for a Better Internet for Kids [24] and the EU Strategy on the Rights of the Child [25]. Thus, exploring factors that could protect or place adolescents at risk of social media threats and how social media threats could harm adolescent health has become crucial for effective decision-making. The present study examined adolescent social media threats and their prevalence, together with the associated individual and social factors, and health outcomes.

Social media threats among adolescents

The social media have brought about a new era of victimization, involving unique challenges and consequences. This is particularly evident in the phenomenon of cyberbullying, defined broadly as bullying via electronic means [26, 27]. Social media allow perpetrators to target their victims at any time and any place (either in front of large audiences or privately) via 24/7 accessibility [28]. Additionally, the possibility of remaining anonymous on these platforms may embolden perpetrators to continue bullying with no fear of repercussions [29]. The absence of face-to-face cues on social media hides the negative consequences of cyberbullying [30], and without this critical feedback, aggressive behaviour may be more likely to recur [12, 31]. In addition, continuous exposure to online aggression can lead individuals to view this behaviour as more acceptable through reinforcement and role modelling, especially if it is rewarded socially [12, 32]. According to a recent systematic review, the prevalence of cyberbullying victimization ranges between 14% and 58% among adolescents [33]. The authors note that one reason for the inconsistency in the prevalence rates is the differences in recall periods across studies (lifetime, last year, last month, etc.); hence, more nuanced research is needed to determine how often adolescents are exposed to cyberbullying [33].

Discrimination via social media, which includes online sexual harassment [9] and racial discrimination [13], presents another significant threat to adolescents. Previous studies have primarily defined online sexual harassment as unwanted sexual behaviour that occurs electronically, such as sending unsolicited sexual messages, images, or requests, or having sexual messages or images shared without permission [9, 34]. Online racial discrimination, on the other hand, refers to any unfair or prejudicial online act based on, for example, race, skin colour, or ethnicity [13]. Noting the easily accessible nature of social media (such that anyone can approach anyone), the rapid dissemination of information, and the broad audience reach, studies have suggested that social media have increased encounters with both forms of discrimination, beyond parental oversight [8]. Social media platforms may amplify discrimination by allowing perpetrators to target multiple victims simultaneously, while remaining anonymous and maintaining a physical distance [9, 35]. Like cyberbullying, the prevalence of online sexual harassment has been inconsistent across adolescent studies (1–59%), partly due to differences in recall periods [36]. The literature on racial discrimination, for its part, has mainly focused on vulnerable populations (e.g., adolescents of colour) [13] or adults [35]. Consequently, the prevalence of adolescents' encounters with racial discrimination remains relatively unknown. One of the few studies on this issue found that out of adolescents

aged 12–16, 17% reported at least monthly exposure to hate messages attacking certain groups or individuals [8].

One social media threat related to both cyberbullying and discrimination – as shown in previous studies [e.g., 37] – is unauthorized sharing of sensitive material (e.g., sexually explicit images). Such material can circulate through adolescent social networks and can be difficult to eradicate from the web [37]. Sensitive material may be shared willingly (e.g., in a relationship), and later disseminated nonconsensually as an act of revenge (e.g., during breakup) [34]. Furthermore, sensitive material can be acquired through phishing attempts by third parties [38]. In both instances, the sensitive material can be used to blackmail the victim [34, 39]. In 2020, 11% of adolescents aged 9–16 had experienced personal data misuse, such as somebody using personal information in a way the victim did not like, or somebody using a person's password to access personal information over the past year [8]. Notably, 20% of adolescents did not know how to change their privacy settings [8], a factor that may place adolescents in a vulnerable situation in terms of privacy.

According to Southwell et al. [14], the current generation of adolescents faces a massive proliferation of rapidly spreading misinformation, i.e., inaccurate or misleading information running contrary to the best scientific evidence [14, 40]. The concern over misinformation was predominantly evident during the COVID-19 pandemic, when a wave of information on the COVID-19 virus spread, especially on social media [23]. Furthermore, a large-scale European study has indicated clear disparities in capabilities to access valid information, with 41% of adolescents reporting an inability to assess the validity of online information [8].

Concerns have also been raised about exposure to risky online content, such as the sale, distribution, and misuse of drugs [41–43]. With increased societal restrictions and parental surveillance over access to most substances, the social media may provide a novel environment for the display of adolescents' risk-taking proclivities [44, 45]. For example, initial evidence points toward the increased use of social media to buy and sell drugs; in this case, the media facilitate easy access to groups where products are distributed and allow contactless deliveries to end-consumers [46]. Social media also foster participation in risky social media challenges [43]. According to previous theories and models, such as the 'super peer' theory [47], and the Facebook Influence Model [41], the social media context amplifies peer influence, due to the increased volume of content portraying risky behaviours, and the quantifiable reinforcement of such behaviour in the forms of 'likes' and comments. The social media context may also exacerbate sensation-seeking by framing risky challenges as exciting and pleasurable [42]. In Europe, on average, 8–17% of adolescents aged 12–16 report that they have faced harmful content online at least monthly. Approximately 10% of adolescents mentioned having viewed content on experiences of taking drugs, how to commit suicide, or how to physically harm oneself [8].

Popular adolescent social media platforms contain an abundance of appearance-focused content [48]. This content tends to promote muscular and athletic ideals for males, such as large biceps, a V-shaped torso, and visible abs. For females, it endorses thin and curvaceous ideals, such as a lean physique, low body fat, and a thin waist with a prominent bottom or bosom [49]. One important way in which the social media differ from traditional media is that the content is user-generated [48]. Adolescents report spending considerable time and effort on their images to represent the 'best' version of themselves, a process which is enhanced by in-built photo-editing tools [50]. Adolescents are thus exposed to idealized and possibly edited content of people, including peers and influencers, through their use of social media [48]. Furthermore, 12% of people aged 12–16 had come upon content on 'ways to be very thin' at least monthly [8].

Factors related to social media threats

There is a growing consensus among researchers that adolescent exposure to social media threats is a complex phenomenon with several explanatory factors. Factors such as gender, age, and capabilities play a role in the threats to which adolescents are exposed. For example, girls are more likely to report online sexual harassment [10] and to encounter appearance-focused social media content [51, 52], whereas boys seem to be more likely to seek out violent material [8], and to have a lower perception of the risks related to publication of data and photographs [53]. Adolescent age has further been hypothesized as explaining social media threat exposure, on the grounds that periods of increased sensitivity to certain threats are likely to occur in relevant developmental windows [15, 54]. For example, Smahel et al. [8] found that adolescents aged 15–16 are more likely than those aged 9–11 to encounter threats such as cyberbullying and personal data misuse. In addition, disparities in capabilities to protect oneself from social media threats have been identified [8]. Emotional intelligence, defined as the ability to identify and comprehend one's own emotions as well as the emotions of others, and to utilize this understanding to effectively regulate one's own behaviour and relationships [55], has been suggested as a protective factor against social media threats [56, 57].

In addition, social factors such as family affluence, family support, and friend support have been linked to adolescent social media threat exposure. Studies on young people have found those with lower socioeconomic status to be more likely to report negative social media experiences, such as receiving hurtful messages, or having

pictures/videos shared without their consent [58, 59]. Conversely, higher family support has been found to significantly reduce adolescents' risk of encountering social media threats. For example, a review study by Elsaesser et al. [60] found that higher family support was consistently associated with lower cyberbullying victimization and perpetration. The relationship between friend support and social media threats, however, is expected to be double-edged. On the one hand, a higher level of friend support has been shown to protect young people from social media threats such as cyberbullying [61]. On the other hand, friend support can enhance the likelihood of encountering and participating in risky behaviours (e.g., dangerous social media challenges) [43].

Research also suggests that social media–related disorders contribute to exposure to social media threats. For example, *problematic social media use* (PSMU) – as indicated by addiction-like symptoms (i.e., withdrawal, conflict, preoccupation) – has been associated with cyberbullying [12], and exposure to misinformation/misconceptions on COVID-19 during the outbreak [62]. The idea of PSMU being associated with social media threats is supported by social theories such as the Problem Behaviour Theory, which suggests that certain risk behaviours are interconnected and contribute to vulnerability [63, 64]. Concerns have also been raised about adolescents who use social media to intensively communicate with strangers. Although uncommon, strangers may pursue ill intentions such as solicitation and harassment [65]. Adolescents may be unable to identify malicious intents due to their sensitivity to acceptance, feelings of rejection, and a lack of self-awareness [5].

Social media threats and health

Adolescents have experienced a significant increase in depression and anxiety over the last decade, and the social media have been suspected as a primary cause [66, 67]. However, the evidence is conflicting. On the one hand, numerous reviews have established a connection between social media use and negative health outcomes among young people [e.g.,68, 69]. On the other hand, a recent umbrella review concluded that the association between social media use and poor adolescent wellbeing was 'weak' and 'inconsistent' [70]. There have been calls for research to shed light on these inconsistent findings, focusing on the mechanisms that could make social media harmful to adolescents' health [67, 70–73]. Encounters with social media threats have been proposed as one such mechanism [74]. Thus far, studies among young people have found cyberbullying, sexual harassment victimization, and racial discrimination to be associated with negative health outcomes such as depressive symptoms and anxiety [9, 10, 75, 76]. Misinformation can negatively influence adolescents' health and health behaviour by eroding their judgement, and by shaping the precursors of their intentions [14]. These can include their attitudes toward behaviour, for example, in terms of approving or disapproving [14]. It may further disrupt their feelings of security, as has happened, for instance, via content related to COVID-19 [77]. Hence, misinformation has been associated with negative moods, anxiety, and distress [77, 78]. Furthermore, threats such as alcohol-related content, and harmful social media challenges have been related to harmful behavioural choices [14, 41, 42]. Idealized appearance-focused content on the social media, for its part, provides adolescents with opportunities to internalize prescriptive ideals, self-objectify, and engage in negative upward appearance comparisons, which could trigger body dissatisfaction [48, 79]. All this would suggest that encounters with social media threats would be a stronger determinant of negative health among adolescents than social media use alone [73].

The current study

The current state of research leaves gaps in our understanding. We lack a comprehensive understanding of how frequently adolescents are exposed to various social media threats in Finland, or within the broader empirical context. There has been relatively little research on the prevalence of certain threats (e.g., dangerous social media challenges, or the sale or distribution of drugs), and the prevalence rates for certain threats (e.g., cyberbullying and sexual harassment) have been inconsistent across studies due to varying reporting frequencies [33, 36]. Some studies have explored the association between individual and social factors and social media threats under specific conditions; however, there has so far been no comprehensive examination of a broad set of individual and social factors in relation to various social media threats [6–8]. Furthermore, despite a recent surge in studies on social media use and health, our understanding of the mechanisms through which social media use might harm adolescent mental health and wellbeing remains limited [67, 70–73]. This emphasizes the need to determine how various social media threats are associated with health outcomes in adolescence. To address these research gaps, the present study aimed to evaluate adolescents' encounters with nine social media threats at distinct intervals: 'never', 'monthly', 'weekly', and 'daily', and their association with individual and social factors, PSMU, online communication with strangers, and health outcomes. Thus, by utilizing a nationally representative sample of Finnish adolescents, the following research questions were addressed:

(RQ1) How prevalent are social media threats (cyberbullying, sexual harassment, racism, unauthorized distribution of sensitive material, phishing attempts, misinformation, sale or distribution of drugs, harmful

or dangerous social media challenges, content causing appearance pressures)?

(RQ2) What are the associations between exposure to social media threats and (i) individual factors (gender, age, emotional intelligence), (ii) social factors (family affluence, family support, friend support), (iii) PSMU, (iv) online communication with strangers?

(RQ3) How are social media threats associated with health (self-rated health, depressive feelings, anxiety)?

Based on previous research, the following hypotheses were formed:

H1 We expected the prevalence of social media threats among adolescents to vary depending on the threat type and the reporting frequency (i.e., never, monthly, weekly, daily). Misinformation was expected to be the most prevalent social media threat on a daily and weekly level, followed by content causing appearance pressures and harmful social media challenges.

H2 Individual and social factors, PSMU, and online communication with strangers were expected to differently explain exposure to social media threats (H2.1). Emotional intelligence and family support were expected to protect adolescents from encountering social media threats, whereas (H2.2) PSMU and online communication with strangers were expected to increase vulnerability to social media threats.

H3 Social media threats were expected to be associated with negative health outcomes, with the associations varying between different social media threats. The association between exposure to a social media threat and negative health outcomes was expected to increase as the prevalence of the exposure increased (i.e., never, monthly, weekly, daily).

Methods

Sample and procedure

Nationally representative data were collected from Finnish adolescents in 2022 as part of the international Health Behaviour in School-aged Children Study (HBSC). The data were collected through anonymous voluntary standardized questionnaires administered to young people aged 11, 13, and 15 via school-based surveys. A stratified random cluster sampling design was used, and the data collection followed guidelines prescribed by the HBSC research protocol [80]. Ethical approval for the study procedures was obtained from the institutional ethics committee of the University of Jyväskylä.

In total, the sample comprised of 2288 Finnish boys (n=1117; 48.8%) and girls (n=1171; 51.2%) between the ages of 11 (n=904; 39.5%), 13 (n=764; 33.4%), and 15 (n=620; 27.1%).

Measures and variables

Social media threats

Social media threats were measured via options covering nine social media threats. Respondents were asked to indicate how often they had encountered cyberbullying, sexual harassment, racism, unauthorized distribution of sensitive material, phishing attempts, misinformation, the sale or distribution of drugs, harmful or dangerous social media challenges, and content that causes appearance pressures. The response options ranged from 1 (daily) to 5 (never). The response options 2 (more than once a week), and 3 (at least once a week) were combined to represent weekly exposure. The items were then reverse scored: 1 = never, 2 = weekly, 3 = monthly, 4 = daily exposure. The social media threats were based on a Delphi study by Lahti et al. [74].

Individual factors

Gender (boy, girl) and *age* (11, 13, 15) were studied by asking respondents to choose the correct alternative [2, 80].

Emotional intelligence was measured using the 10-item Brief Emotional Intelligence Scale [81]. Respondents were asked to indicate if they knew why their emotions changed, if they could easily recognize their emotions as they experienced them, if they could tell how people were feeling by listening to their tone of voice, or by looking at their facial expressions, if they recognized the emotions people were experiencing, if they sought out activities that made them happy, if they had control over their emotions, if they arranged events that others enjoyed, if they helped other people to feel better when they were in low spirits, if they were able to come up with new ideas when in a positive mood, and if they used good moods to make themselves keep trying in the face of obstacles. The response scale ranged from 1) 'describes me very poorly' to 5) 'describes me very well'. A mean score (range 0–5) was calculated from the items to indicate adolescent emotional intelligence. The scale has been validated and found reliable [81]. The Cronbach alpha of the composite score was 0.89, exceeding the Cronbach alpha coefficient found by Aronen et al. [82] using a small sample of 51 Finnish adults.

Social factors

The Family Affluence Scale III (FAS) [83] was used to measure the family's socioeconomic position. The respondents were asked about the family's ownership of a car, the family's ownership of a dishwasher, having one's own bedroom, number of family computers, number of family bathrooms, and number of family vacations during the past 12 months. A sum score was calculated from the items to indicate family affluence, in line with the

suggestions of Elgar et al. [84]. The FAS III has been validated and shown to be appropriate in adolescent studies [83].

Family support was measured via Zimet et al.'s [85] Multidimensional Scale of Perceived Social Support. Respondents were asked to indicate whether 'my family really tries to help me', 'I get the help and emotional support I need from my family', 'I can talk about my problems with my family', and 'my family is willing to help me in decision-making'. The response options ranged from 1 (very strongly disagree) to 7 (very strongly agree). A mean score (range 0–7) was calculated and used to indicate family support. The scale has been validated [86, 87], and has shown good reliability (Cronbach's alpha 0.96).

Friend support was measured via Zimet et al.'s [85] Multidimensional Scale of Perceived Social Support. Respondents were asked to indicate whether 'my friends really try to help me', 'I can count on my friends when something goes wrong', 'I have friends with whom I can share my joys and sorrows', 'I can talk about my problems with my friends'. The response options ranged from 1 (very strongly disagree) to 7 (very strongly agree). A mean score (range 0–7) was calculated and used to indicate friend support. The scale has been validated [86, 87], and has shown good reliability (Cronbach's alpha 0.96).

PSMU and online communication with strangers

Problematic social media use was measured via nine items of the Social Media Disorder Scale [88, 89]. Respondents were asked whether they, in the past year, regularly could not stop thinking about social media (preoccupation), felt dissatisfied because they wanted to devote more time to social media (tolerance), often felt bad when they were unable to use social media (withdrawal), failed in efforts to reduce time spent on social media (persistence), regularly neglected doing other things because of social media (displacement), regularly had arguments with others because of their use of social media (problem), regularly lied to parents or friends about how much time they spent on social media (deception), often used social media to escape from negative feelings (escape), and had severe conflicts with parents or siblings because of their use of social media (conflict). The response options were 1 'yes' and 0 'no'. Respondents who answered positively to 6–9 items were classified as 2=problematic user, while the rest were classified as 1=non-problematic user [88–90]. The scale has been found to be valid and reliable [88]. The internal consistency of the scale was adequate (Cronbach's alpha 0.82).

Online communication with strangers was assessed using an item adapted from the EU Kids Online Survey [91]. Respondents were asked how often they had online contact through social media with unknown people. The responses ranged from 1 (never/almost never) to 5 (almost all the time throughout the day), with also a 'do not know/does not apply' option. Respondents answering with option 5 were categorized as 2=having intensive online communication with strangers, whereas the respondents answering with options 1–4 were categorized as 1=not having intensive communication with strangers. The categorization was based on previous studies utilizing the same item with different demographics such as close friends [e.g., 2, 92–94].

Health

Self-rated health (SRH) was measured via a single question on the individual's evaluation of their health [95]. The response options were *poor, fair, good*, and *excellent*. Respondents who answered good and excellent were classified as having 1=good SRH, whereas those answering fair and poor were classified as having 2=poor SRH [see e.g., 96]. SRH has been shown to be a robust item [97], and valid in adolescent samples [98].

Depressive feelings were measured as part of the HBSC symptoms checklist [99]. The respondents were asked how often they had experienced depressive feelings over the last six months. The response options ranged from 1 (rarely or never) to 5 (about every day). Those having depressive feelings rarely or never or monthly were classified as 1=not having depressive feelings frequently. Those having depressive feelings about every week, more than once a week, and about every day were combined and classified as 2=having depressive feelings frequently. The item has been validated in an adolescent sample and has been found to have adequate reliability [100].

Anxiety was measured as part of the HBSC symptoms checklist [99]. The respondents were asked how often they had experienced anxiety over the last six months. The response options ranged from 1 (rarely or never) to 5 (about every day). Those having anxiety symptoms rarely, never, or monthly were classified as 1=not having anxiety symptoms frequently. Those having anxiety symptoms about every week, more than once a week, and about every day were classified as 2=having anxiety symptoms frequently.

Statistical analyses

Missing data ranged between 1.4% (gender) and 15.6% (problematic social media use). To overcome the potential bias associated with listwise deletion, we utilized multiple imputation by chained equations. Multiple imputation reduces the potential bias related to missing data even when the percentage of missing data is high [101]. The missing data were imputed on the basis of available data on other included study variables. Five imputations were conducted, in line with the suggestions of Madley-Dowd et al. [101]; thus, all 2288 respondents were retained for the analyses.

The associations between *individual and social factors*, *PSMU, online communication with strangers*, and *social media threats* were tested using fixed effects multinomial logistic regression analyses, and reported as odds ratios (ORs). For the social media threats, 'Never' was used as the reference category. A separate analysis of 15-year-olds was performed for *emotional intelligence*, as the variable was only measured in this age group. Variables were added to the models hierarchically, and adjusted effects were reported.

Fixed effects binary logistic regression analyses were conducted to study the association between social media threats and health outcomes. The regression models were performed on each health outcome separately, and the analyses were adjusted for gender, age, and family affluence. All fixed effects logistic regression models were tested for the clustering effect of schools in the data. The analyses were conducted with IBM SPSS Statistics 28.0 [102].

Results

The prevalence of social media threats

As shown in Table 1, the two most prevalent social media threats encountered by adolescents daily were *misinformation* (12.9%) and *content causing appearance pressures* (9.1%). On a weekly basis, the most prevalent social media threats were *misinformation* (44.2%) and *harmful or dangerous social media challenges* (22.3%). In terms of monthly exposure, the most prevalent social media threats were *unauthorized distribution of sensitive material* (27.7%) and *harmful or dangerous social media challenges* (26.8%). The least prevalent social media threats (in terms of the 'never encountered' option) were *cyberbullying* (79.5%) and *sexual harassment* (77.7%).

The associations of individual factors with social media threats

As indicated by Table 2, significant associations were identified between social media threats and individual factors. In terms of *encountering social media threats daily*, seven out of the nine threats were more likely to be reported by boys, including cyberbullying (OR=0.28, CI 95% = 0.15–0.53), sexual harassment (OR=0.51, CI 95% = 0.27–0.96), racism (OR=0.47, CI 95% = 0.31–0.70), unauthorized distribution of sensitive material (OR=0.37, CI 95% = 0.24–0.57), phishing attempts (OR=0.18, CI 95% = 0.11–0.32), misinformation (OR=0.47, CI 95% = 0.34–0.66), and harmful or dangerous social media challenges

Table 1 Prevalence of social media threats

	Daily	Weekly	Monthly	Never	Total	Significance	
	%	%	%	%	(n)	χ^2	*p* value
Cyberbullying	2.8	6.8	10.9	79.5	2288		
Gender, girl	1.5	3.8	12.1	82.6	1171	50.79	< 0.001
Boy	4.1	9.9	9.7	76.3	1117		
Sexual harassment	3.0	7.6	11.7	77.7	2288		
Gender, girl	2.0	7.1	16.5	74.4	1171	59.90	< 0.001
Boy	4.1	8.2	6.6	81.1	1117		
Racism	6.3	18.4	19.1	56.2	2288		
Gender, girl	3.8	20.3	23.7	52.2	1171	62.34	< 0.001
Boy	9.0	16.4	14.3	60.3	1117		
Unauthorized distribution of sensitive material	5.6	22.2	27.7	44.5	2288		
Gender, girl	3.3	22.1	30.2	44.4	1171	27.59	< 0.001
Boy	7.9	22.4	25.0	44.7	1117		
Phishing attempts	4.3	12.5	20.7	62.5	2288		
Gender, girl	1.7	8.8	23.7	65.8	1171	76.77	< 0.001
Boy	6.9	16.3	17.6	59.2	1117		
Misinformation	12.9	44.2	25.6	17.3	2288		
Gender, girl	8.4	46.4	28.4	16.8	1171	49.65	< 0.001
Boy	17.8	41.9	22.6	17.7	1117		
Sale or distribution of drugs	8.5	18.2	13.4	59.9	2288		
Gender, girl	8.9	19.5	14.7	56.9	1171	8.96	0.054
Boy	8.2	17.0	12.0	62.8	1117		
Harmful or dangerous social media challenges	5.6	22.3	26.8	45.3	2288		
Gender, girl	3.3	22.1	32.9	41.7	1171	62.55	< 0.001
Boy	8.0	22.4	20.5	49.1	1117		
Content that causes appearance pressures	9.1	18.9	15.3	56.7	2288		
Gender, girl	13.3	25.9	19.6	41.2	1171	237.21	< 0.001
Boy	4.7	11.7	10.9	72.8	1117		

(OR=0.42, CI 95% = 0.27–0.65). By contrast, content causing appearance pressures (OR=6.71, CI 95% = 4.51–9.98) was the only threat more likely to be reported by girls.

In terms of *weekly exposure*, cyberbullying (OR=0.32, CI 95% = 0.21–0.48) and phishing attempts (OR=0.43, CI 95% = 0.32–0.57) were more likely to be reported by boys, whereas exposure to racism (OR=1.40, CI 95% = 1.10–1.79) and content causing appearance pressures (OR=4.79, CI 95% = 3.65–6.29) were more likely to be reported by girls. Girls were also more likely to report *monthly* exposure to sexual harassment (OR=2.53, CI 95% = 1.75–3.64), racism (OR=1.89, CI 95% = 1.49–2.41), misinformation (OR=1.34, CI 95% = 1.02–1.75), harmful and dangerous challenges (OR=1.89, CI 95% = 1.53–2.35), and content causing appearance pressures (OR=3.71, CI 95% = 2.84–4.84).

Adolescents aged 15 self-reported *daily* (ORs 2.82–20.89) and *weekly* (ORs 2.05–11.11) exposure to every social media threat more than did those aged 11 (Table 2). Similarly, compared to 11-year-olds, 13-year-olds were more likely to encounter six out of the nine social media threats *daily* (ORs 2.00–7.71), every social media threat *weekly* (ORs 2.20–5.21), and eight out of the nine threats *monthly* (ORs 1.42–3.12). Adolescents with higher emotional intelligence were less likely to report *daily* exposure to cyberbullying (OR=0.40, CI 95% = 0.23–0.72), sexual harassment (OR=0.34, CI 95% = 0.17–0.70), racism (OR=0.57, CI 95% = 0.36–0.89), unauthorized distribution of sensitive material (OR=0.57, CI 95% = 0.35–0.94), and phishing attempts (OR=0.49, CI 95% = 029–0.84).

The association of social factors with social media threats

Adolescents with higher family affluence were more likely to report *daily* encounters with misinformation (OR 2.24, CI 95% = 1.25–4.03), sale or distribution of drugs (OR=1.85, CI 95% = 1.03–3.35), and content causing appearance pressures (OR=1.81, CI 95% = 1.00–3.29), *weekly* exposure to content causing appearance pressures (OR=1.67, CI 95% = 1.05–2.65), *monthly* encounters with harmful social media challenges (OR=1.76, CI 95% = 1.21–2.57), or content causing appearance pressures (OR=2.63, CI 95% = 1.66–4.18; Table 3).

Adolescents with higher family support were less likely to report *daily* (ORs 0.60–0.78) and *weekly* (ORs 0.72–0.87) exposure to eight out of the nine social media threats, and *monthly* (ORs 0.78–0.86) exposure to three social media threats. In terms of social support from friends, adolescents with higher support were more likely to report *daily* encounters with the sale or distribution of drugs (OR=1.19, CI 95% = 1.05–1.36), but less likely to report *daily* (OR=0.78, CI 95% = 0.64–0.94) and *weekly* (OR=0.75, CI 95% = 0.65–0.85) encounters with cyberbullying.

The association of PSMU and online communication with strangers with social media threats

Adolescents with PSMU were more likely to report *daily* (ORs 3.00–5.66) and *weekly* (ORs 1.58–4.72) exposure to every social media threat except misinformation (Table 4). For example, problematic users were more than five times as likely to report *daily* exposure to cyberbullying (OR=5.64, CI 95% = 2.97–10.69) and sexual harassment (OR=5.66, CI 95% = 3.07–10.42). Those who reported intensive online communication with strangers were more likely to encounter eight out of the nine social media threats *daily* (ORs 2.03–6.02), as well as exposure to four social media threats *weekly* (ORs 1.96–2.91).

The association of social media threats with health

Adolescents who encountered any of the social media threats *daily* or *weekly* were more likely to report having poor self-rated health, frequent depressive feelings, and frequent anxiety symptoms, as compared to those who never reported such encounters. For instance, those exposed to misinformation *daily* were almost three times as likely to report poor self-rated health (OR=2.83, CI 95% = 1.68–4.76), and approximately four times as likely to report frequent depressive feelings (OR=4.15, CI 95% = 2.63–6.54) and frequent anxiety symptoms (OR=3.78, CI 95% = 2.47–5.78; Table 5). Furthermore, adolescents who encountered any of the threats as infrequently as *once a month* were more likely to report having frequent depressive feelings than those who *never* experienced such threats (ORs 1.33–2.48). Similarly, adolescents with *monthly* exposure to eight out of the nine threats were more likely to report frequent anxiety symptoms (ORs 1.62–2.60). Adolescents exposed *monthly* to cyberbullying, sexual harassment, or phishing attempts were more likely to report poor self-rated health (ORs 1.54–1.97).

Discussion

The study investigated the prevalence among adolescents of nine social media threats, the associations of individual and social factors, PSMU, and online communication with strangers with the nine threats, and the association of such threats with health.

We expected the prevalence of exposure to different social media threats to vary among adolescents, depending on the threat type and the reporting frequency (H1). This hypothesis was confirmed by the findings. At a *daily* level, the most common social media threats were misinformation (12.9%) and content causing appearance pressures (9.1%), and at a *weekly* level misinformation (44.2%), harmful social media challenges (22.3%), and unauthorized distribution of sensitive material (22.2%).

Table 2 The association of individual factors with social media threats

Variable	Gender (ref. boy)		Age (ref. 11y)				Emotional intelligence (continuous)	
			13y		15y			
	OR (CI 95%)	*p* value	OR (CI 95%)	*p* value	OR (CI 95%)	*p* value	OR (CI 95%)	*p* value
Cyberbullying (ref. never)								
Daily	**0.28 (0.15–0.53)**	**< 0.001**	1.62 (0.78–3.35)	0.198	**2.82 (1.38–5.76)**	**0.005**	**0.40 (0.23–0.72)**	**0.003**
Weekly	**0.32 (0.21–0.48)**	**< 0.001**	**2.24 (1.40–3.59)**	**< 0.001**	**2.05 (1.26–3.31)**	**0.004**	0.71 (0.44–1.15)	0.162
Monthly	1.10 (0.82–1.48)	0.517	1.02 (0.72–1.45)	0.892	1.12 (0.79–1.60)	0.519	0.89 (0.57–1.39)	0.605
Sexual harassment (ref. never)								
Daily	**0.51 (0.27–0.96)**	**0.038**	1.82 (0.83–4.01)	0.135	**3.72 (1.89–7.31)**	**< 0.001**	**0.34 (0.17–0.70)**	**0.005**
Weekly	0.91 (0.63–1.30)	0.601	**3.31 (1.98–5.53)**	**< 0.001**	**4.43 (2.66–7.36)**	**< 0.001**	0.73 (0.47–1.14)	0.169
Monthly	**2.53 (1.75–3.64)**	**< 0.001**	**2.03 (1.36–3.01)**	**< 0.001**	**4.24 (2.95–6.07)**	**< 0.001**	0.94 (0.61–1.43)	0.753
Racism (ref. never)								
Daily	**0.47 (0.31–0.70)**	**< 0.001**	**5.36 (3.06–9.38)**	**< 0.001**	**7.19 (4.15–12.45)**	**< 0.001**	**0.57 (0.36–0.89)**	**0.015**
Weekly	**1.40 (1.10–1.79)**	**0.006**	**3.04 (2.23–4.14)**	**< 0.001**	**3.52 (2.54–4.87)**	**< 0.001**	0.80 (0.55–1.15)	0.221
Monthly	**1.89 (1.49–2.41)**	**< 0.001**	**2.61 (1.98–3.45)**	**< 0.001**	**2.92 (2.19–3.90)**	**< 0.001**	1.21 (0.82–1.78)	0.336
Unauthorized distribution of sensitive material (ref. never)								
Daily	**0.37 (0.24–0.57)**	**< 0.001**	**3.15 (1.81–5.49)**	**< 0.001**	**5.86 (3.40–10.10)**	**< 0.001**	**0.57 (0.35–0.94)**	**0.026**
Weekly	0.91 (0.71–1.16)	0.436	**2.87 (2.13–3.88)**	**< 0.001**	**4.61 (3.41–6.23)**	**< 0.001**	0.92 (0.63–1.33)	0.640
Monthly	1.15 (0.92–1.44)	0.215	**2.05 (1.60–2.63)**	**< 0.001**	**3.04 (2.31–4.01)**	**< 0.001**	0.96 (0.65–1.41)	0.824
Phishing attempts (ref. never)								
Daily	**0.18 (0.11–0.32)**	**< 0.001**	2.07 (0.98–4.39)	0.057	**4.78 (2.44–9.38)**	**< 0.001**	**0.49 (0.29–0.84)**	**0.010**
Weekly	**0.43 (0.32–0.57)**	**< 0.001**	**2.20 (1.56–3.11)**	**< 0.001**	**2.79 (1.96–3.96)**	**< 0.001**	0.76 (0.49–1.17)	0.203
Monthly	1.16 (0.93–1.45)	0.194	**1.99 (1.49–2.68)**	**< 0.001**	**3.39 (2.59–4.46)**	**< 0.001**	1.09 (0.79–1.52)	0.601
Misinformation (ref. never)								
Daily	**0.47 (0.34–0.66)**	**< 0.001**	**3.29 (2.18–4.97)**	**< 0.001**	**5.62 (3.69–8.57)**	**< 0.001**	1.03 (0.64–1.65)	0.911
Weekly	1.12 (0.87–1.45)	0.378	**2.77 (2.07–3.70)**	**< 0.001**	**3.73 (2.62–5.31)**	**< 0.001**	1.22 (0.80–1.84)	0.356
Monthly	**1.34 (1.02–1.75)**	**0.033**	**1.42 (1.04–1.94)**	**0.028**	**1.53 (1.06–2.19)**	**0.022**	1.21 (0.73–2.01)	0.463
Sale or distribution of drugs (ref. never)								
Daily	1.08 (0.75–1.54)	0.691	**7.71 (4.27–13.94)**	**< 0.001**	**20.89 (11.86–36.80)**	**< 0.001**	0.98 (0.64–1.51)	0.928
Weekly	1.19 (0.90–1.56)	0.215	**5.21 (3.72–7.28)**	**< 0.001**	**11.11 (7.90–15.61)**	**< 0.001**	0.92 (0.65–1.31)	0.651
Monthly	1.25 (0.93–1.68)	0.133	**3.12 (2.24–4.33)**	**< 0.001**	**4.95 (3.51–6.98)**	**< 0.001**	0.82 (0.56–1.20)	0.303
Harmful social media challenges (ref. never)								
Daily	**0.42 (0.27–0.65)**	**< 0.001**	**2.00 (1.19–3.38)**	**0.009**	**4.24 (2.58–6.96)**	**< 0.001**	0.70 (0.45–1.10)	0.123
Weekly	1.13 (0.89–1.42)	0.319	**2.55 (1.90–3.41)**	**< 0.001**	**3.43 (2.53–4.64)**	**< 0.001**	0.85 (0.57–1.27)	0.421
Monthly	**1.89 (1.53–2.35)**	**< 0.001**	**1.92 (1.48–2.51)**	**< 0.001**	**2.58 (1.96–3.39)**	**< 0.001**	0.87 (0.59–1.28)	0.473
Content that causes appearance pressures (ref. never)								
Daily	**6.71 (4.51–9.98)**	**< 0.001**	**4.27 (2.70–6.78)**	**< 0.001**	**5.85 (3.64–9.42)**	**< 0.001**	0.62 (0.35–1.08)	0.088
Weekly	**4.79 (3.65–6.29)**	**< 0.001**	**3.55 (2.53–4.96)**	**< 0.001**	**5.68 (4.12–7.85)**	**< 0.001**	0.82 (0.57–1.17)	0.276
Monthly	**3.71 (2.84–4.84)**	**< 0.001**	**2.93 (2.14–4.01)**	**< 0.001**	**2.75 (1.97–3.83)**	**< 0.001**	0.87 (0.56–1.35)	0.522

Fixed-effect multinomial logistic regression models: odds ratios (OR); 95% confidence intervals (CI); *ref.* reference category.

The significance level was set at $p < 0.05$. The significant associations have been **bolded**

Regression models for each social media threat were run separately. The models were adjusted for gender, age, emotional intelligence, FAS, family support, friend support, PSMU, online communication with strangers. Social media threats were treated as outcome variables in the models

Emotional intelligence was only included for 15-year-olds

Table 3 The association of social factors with social media threats

Variable	Family affluence (continuous)		Family support (continuous)		Friend support (continuous)	
	OR (CI 95%)	*p* value	OR (CI 95%)	*p* value	OR (CI 95%)	*p* value
Cyberbullying (ref. never)						
Daily	1.32 (0.45–3.88)	0.605	**0.70 (0.57–0.86)**	**< 0.001**	**0.78 (0.64–0.94)**	**0.010**
Weekly	0.76 (0.38–1.53)	0.440	**0.82 (0.72–0.93)**	**0.003**	**0.75 (0.65–0.85)**	**< 0.001**
Monthly	1.08 (0.64–1.82)	0.770	0.92 (0.82–1.03)	0.131	0.91 (0.81–1.02)	0.088
Sexual harassment (ref. never)						
Daily	0.60 (0.22–1.61	0.304	**0.60 (0.49–0.72)**	**< 0.001**	0.94 (0.78–1.13)	0.507
Weekly	1.22 (0.54–2.79)	0.619	**0.72 (0.62–0.83)**	**< 0.001**	0.95 (0.83–1.09)	0.474
Monthly	1.00 (0.61–1.64)	0.997	**0.78 (0.70–0.87)**	**< 0.001**	1.05 (0.94–1.17)	0.391
Racism (ref. never)						
Daily	1.99 (0.94–4.19)	0.071	**0.78 (0.67–0.90)**	**< 0.001**	1.00 (0.87–1.16)	0.974
Weekly	1.00 (0.61–1.63)	0.983	**0.86 (0.78–0.94)**	**< 0.001**	0.96 (0.87–1.05)	0.311
Monthly	1.04 (0.69–1.58)	0.848	0.96 (0.87–1.07)	0.485	1.01 (0.91–1.11)	0.860
Unauthorized distribution of sensitive material (ref. never)						
Daily	1.72 (0.72–4.10)	0.212	**0.72 (0.62–0.84)**	**< 0.001**	1.04 (0.89–1.21)	0.654
Weekly	1.53 (0.99–2.37)	0.055	**0.84 (0.76–0.93)**	**< 0.001**	0.97 (0.89–1.07)	0.578
Monthly	1.25 (0.86–1.81)	0.245	0.95 (0.87–1.04)	0.248	1.03 (0.94–1.12)	0.537
Phishing attempts (ref. never)						
Daily	1.92 (0.82–4.54)	0.134	**0.75 (0.64–0.88)**	**< 0.001**	0.86 (0.72–1.01)	0.062
Weekly	1.15 (0.69–1.89)	0.598	**0.82 (0.73–0.91)**	**< 0.001**	0.93 (0.83–1.05)	0.246
Monthly	1.13 (0.73–1.75)	0.579	0.98 (0.90–1.08)	0.738	0.96 (0.87–1.05)	0.318
Misinformation (ref. never)						
Daily	**2.24 (1.25–4.03)**	**0.007**	0.93 (0.80–1.07)	0.298	0.91 (0.78–1.05)	0.195
Weekly	1.48 (0.93–2.34)	0.099	0.96 (0.86–1.07)	0.475	0.93 (0.83–1.04)	0.203
Monthly	1.18 (0.71–1.98)	0.525	1.07 (0.94–1.21)	0.318	0.94 (0.83–1.06)	0.304
Sale or distribution of drugs (ref. never)						
Daily	**1.85 (1.03–3.35)**	**0.041**	**0.68 (0.59–0.78)**	**< 0.001**	**1.19 (1.05–1.36)**	**0.009**
Weekly	1.57 (0.95–2.58)	0.076	**0.79 (0.72–0.87)**	**< 0.001**	1.05 (0.95–1.16)	0.331
Monthly	1.07 (0.66–1.72)	0.796	**0.85 (0.76–0.96)**	**0.006**	1.11 (0.99–1.23)	0.071
Harmful social media challenges (ref. never)						
Daily	1.51 (0.61–3.77)	0.359	**0.65 (0.55–0.75)**	**< 0.001**	1.13 (0.97–1.32)	0.111
Weekly	1.34 (0.87–2.06)	0.180	**0.87 (0.79–0.95)**	**0.003**	0.98 (0.89–1.07)	0.596
Monthly	**1.76 (1.21–2.57)**	**0.003**	0.95 (0.87–1.04)	0.293	0.97 (0.89–1.06)	0.479
Content that causes appearance pressures (ref. never)						
Daily	**1.81 (1.00–3.29)**	**0.050**	**0.63 (0.55–0.71)**	**< 0.001**	1.00 (0.89–1.13)	0.997
Weekly	**1.67 (1.05–2.65)**	**0.029**	**0.79 (0.71–0.88)**	**< 0.001**	0.94 (0.85–1.04)	0.236
Monthly	**2.63 (1.66–4.18)**	**< 0.001**	**0.86 (0.76–0.97)**	**0.014**	0.95 (0.85–1.06)	0.312

Fixed-effect multinomial logistic regression models: odds ratios (OR); 95% confidence intervals (CI); *ref.* reference category

The significance level was set at $p < 0.05$. The significant associations have been **bolded**

Regression models for each social media threat were run separately. The models were adjusted for gender, age, emotional intelligence, FAS, family support, friend support, PSMU, online communication with strangers. Social media threats were treated as outcome variables in the models

Emotional intelligence was only included for 15-year-olds

Exposure to misinformation was the threat least often expressed as 'never encountered' (17.3%). The findings of our study are in line with previous research indicating that, in particular, misinformation has rapidly proliferated in adolescent social media [14]. Our findings also show the unauthorized distribution of sensitive material to be more common than previously reported [59]. Furthermore, our results shed new light on the prevalence of harmful or dangerous social media challenges among adolescents, bearing in mind that previous studies have focused on adults [43], or on harmful content (but not in the form of challenges) [8], or else have been limited to specific platforms [103] or specific challenges [104]. It should be borne in mind that the prevalence of social media threats per se is not the sole indicator of the harmfulness of threats for adolescents. For instance, cyberbullying and sexual harassment, reported on a daily or a weekly basis by 9.6% (for cyberbullying) and 10.6% (for

Table 4 The association of PSMU and online communication with strangers with social media threats

Variable	Problematic social media use (ref. non-problematic use)		Online communication with strangers (ref. non-intensive communication)	
	OR (*CI* 95%)	*p* value	OR (*CI* 95%)	*p* value
Cyberbullying (ref. never)				
Daily	**5.64 (2.97–10.69)**	**< 0.001**	**3.98 (1.59–10.00)**	**0.004**
Weekly	**4.72 (2.84–7.82)**	**< 0.001**	1.94 (0.96–3.95)	0.067
Monthly	**2.68 (1.71–4.20)**	**< 0.001**	1.17 (0.59–2.33)	0.658
Sexual harassment (ref. never)				
Daily	**5.66 (3.07–10.42)**	**< 0.001**	**5.82 (2.58–13.15)**	**< 0.001**
Weekly	**3.05 (1.83–5.08)**	**< 0.001**	**2.91 (1.60–5.28)**	**< 0.001**
Monthly	**1.97 (1.26–3.09)**	**0.003**	1.74 (0.84–3.60)	0.133
Racism (ref. never)				
Daily	**3.00 (1.77–5.10)**	**< 0.001**	**3.43 (1.77–6.68)**	**< 0.001**
Weekly	**1.83 (1.21–2.75)**	**0.004**	**2.32 (1.37–3.94)**	**0.002**
Monthly	1.08 (0.67–1.72)	0.763	1.14 (0.60–2.16)	0.686
Unauthorized distribution of sensitive material (ref. never)				
Daily	**4.58 (2.57–8.16)**	**< 0.001**	**4.36 (2.10–9.05)**	**< 0.001**
Weekly	**2.47 (1.62–3.77)**	**< 0.001**	1.85 (0.91–3.77)	0.089
Monthly	1.28 (0.81–2.02)	0.299	1.18 (0.61–2.25)	0.624
Phishing attempts (ref. never)				
Daily	**4.08 (2.22–7.49)**	**< 0.001**	**6.02 (2.93–12.36)**	**< 0.001**
Weekly	**3.08 (2.03–4.68)**	**< 0.001**	**2.52 (1.20–5.30)**	**0.017**
Monthly	1.36 (0.84–2.21)	0.209	1.72 (0.97–3.05)	0.064
Misinformation (ref. never)				
Daily	1.50 (0.77–2.92)	0.229	1.97 (0.82–4.76)	0.127
Weekly	1.05 (0.64–1.73)	0.846	1.00 (0.46–2.16)	0.997
Monthly	0.71 (0.39–1.32)	0.276	0.76 (0.33–1.76)	0.525
Sale or distribution of drugs (ref. never)				
Daily	**3.84 (2.19–6.73)**	**< 0.001**	**2.03 (1.01–4.10)**	**0.048**
Weekly	**2.40 (1.54–3.76)**	**< 0.001**	0.97 (0.53–1.79)	0.932
Monthly	1.75 (0.93–3.28)	0.081	0.58 (0.24–1.39)	0.218
Harmful social media challenges (ref. never)				
Daily	**3.85 (2.14–6.94)**	**< 0.001**	**3.18 (1.51–6.71)**	**0.002**
Weekly	**1.58 (1.04–2.39)**	**0.031**	**1.96 (1.12–3.43)**	**0.019**
Monthly	0.97 (0.61–1.54)	0.888	1.66 (0.92–2.99)	0.090
Content that causes appearance pressures (ref. never)				
Daily	**4.40 (2.55–7.60)**	**< 0.001**	**2.13 (1.12–4.06)**	**0.021**
Weekly	**2.86 (1.76–4.65)**	**< 0.001**	0.93 (0.49–1.77)	0.819
Monthly	**1.95 (1.07–3.55)**	**0.031**	1.08 (0.57–2.05)	0.808

Fixed-effect multinomial logistic regression models: odds ratios (OR); 95% confidence intervals (CI); *ref.* reference category

The significance level was set at $p < 0.05$. The significant associations have been **bolded**

Regression models for each social media threat were run separately. The models were adjusted for gender, age, emotional intelligence, FAS, family support, friend support, PSMU, online communication with strangers. Social media threats were treated as outcome variables in the models

Emotional intelligence was only included for 15-year-olds

sexual harassment), are inherently more serious threats compared to, for instance, misinformation [74]. Both cyberbullying and sexual harassment specifically target the individual recipient of the message, while several other threats can to some extent affect anyone who comes across the message. Nevertheless, given that vulnerabilities beget vulnerabilities among adolescents [6], it is likely that social media threats co-occur, and that certain adolescents face many threats simultaneously; hence, the possibility of widening disparities should be considered [see 105].

We expected that individual and social factors, PSMU, and online communication with strangers would differently explain exposure to various social media threats (H2) This hypothesis was also confirmed. In line with previous studies [51], we found that girls were more likely to encounter content causing appearance pressures. Boys, on the other hand, were more likely to report daily

Table 5 The association of social media threats with health

Variable	Self-rated health (ref. good self-rated health)		Depressive feelings (ref. no frequent depressive feelings)		Anxiety (ref. no frequent anxiety)	
	OR (CI 95%)	*p* value	OR (CI 95%)	*p* value	OR (CI 95%)	*p* value
Cyberbullying (ref. never)						
Daily	**2.55 (1.31–4.97)**	**0.006**	**3.15 (1.69–5.85)**	**< 0.001**	**2.99 (1.59–5.61)**	**< 0.001**
Weekly	**3.20 (1.97–5.21)**	**< 0.001**	**2.75 (1.67–4.53)**	**< 0.001**	**3.63 (2.37–5.54)**	**< 0.001**
Monthly	**1.97 (1.35–2.88)**	**< 0.001**	**2.48 (1.79–3.43)**	**< 0.001**	**2.60 (1.84–3.66)**	**< 0.001**
Sexual harassment (ref. never)						
Daily	**3.14 (1.50–6.61)**	**0.004**	**4.08 (2.16–7.71)**	**< 0.001**	**3.62 (2.05–6.41)**	**< 0.001**
Weekly	**3.37 (2.24–5.08)**	**< 0.001**	**2.49 (1.66–3.73)**	**< 0.001**	**3.07 (2.10–4.50)**	**< 0.001**
Monthly	**1.54 (1.06–2.24)**	**0.023**	**2.22 (1.64–3.01)**	**< 0.001**	**2.34 (1.70–3.23)**	**< 0.001**
Racism (ref. never)						
Daily	**2.53 (1.57–4.09)**	**< 0.001**	**4.42 (2.66–7.33)**	**< 0.001**	**3.47 (2.26–5.34)**	**< 0.001**
Weekly	**1.98 (1.41–2.79)**	**< 0.001**	**2.87 (2.13–3.86)**	**< 0.001**	**2.99 (2.27–3.94)**	**< 0.001**
Monthly	1.01 (0.70–1.45)	0.977	**1.47 (1.10–1.97)**	**0.010**	**1.62 (1.25–2.11)**	**< 0.001**
Unauthorized distribution (ref. never)						
Daily	**3.32 (1.97–5.59)**	**< 0.001**	**3.51 (2.16–5.72)**	**< 0.001**	**3.12 (1.94–5.04)**	**< 0.001**
Weekly	**2.38 (1.71–3.32)**	**< 0.001**	**2.19 (1.62–2.97)**	**< 0.001**	**3.57 (2.59–4.92)**	**< 0.001**
Monthly	1.35 (0.96–1.91)	0.084	**1.53 (1.13–2.09)**	**0.007**	**1.65 (1.25–2.18)**	**< 0.001**
Phishing attempts (ref. never)						
Daily	**3.81 (2.10–6.88)**	**< 0.001**	**3.37 (1.99–5.72)**	**< 0.001**	**4.34 (2.62–7.18)**	**< 0.001**
Weekly	**3.06 (2.10–4.46)**	**< 0.001**	**2.61 (1.85–3.69)**	**< 0.001**	**3.04 (2.18–4.24)**	**< 0.001**
Monthly	**1.89 (1.34–2.67)**	**< 0.001**	**1.33 (1.01–1.75)**	**0.044**	**1.73 (1.30–2.30)**	**< 0.001**
Misinformation (ref. never)						
Daily	**2.83 (1.68–4.76)**	**< 0.001**	**4.15 (2.63–6.54)**	**< 0.001**	**3.78 (2.47–5.78)**	**< 0.001**
Weekly	**1.93 (1.22–3.05)**	**0.005**	**2.53 (1.73–3.69)**	**< 0.001**	**2.72 (1.97–3.74)**	**< 0.001**
Monthly	1.43 (0.87–2.36)	0.159	**1.54 (1.02–2.31)**	**0.040**	1.33 (0.93–1.90)	0.121
Sale or distribution of drugs (ref. never)						
Daily	**2.02 (1.26–3.24)**	**0.004**	**3.20 (2.17–4.73)**	**< 0.001**	**3.94 (2.72–5.70)**	**< 0.001**
Weekly	**1.80 (1.26–2.58)**	**0.001**	**1.86 (1.38–2.52)**	**< 0.001**	**2.75 (2.06–3.67)**	**< 0.001**
Monthly	1.16 (0.77–1.75)	0.479	**1.43 (1.02–1.99)**	**0.038**	**1.62 (1.17–2.24)**	**0.004**
Harmful social media challenges (ref. never)						
Daily	**2.13 (1.24–3.66)**	**0.007**	**4.18 (2.56–6.84)**	**< 0.001**	**4.58 (2.70–7.77)**	**< 0.001**
Weekly	**1.65 (1.13–2.42)**	**0.011**	**2.42 (1.80–3.26)**	**< 0.001**	**2.81 (2.09–3.76)**	**< 0.001**
Monthly	1.11 (0.80–1.55)	0.524	**1.59 (1.18–2.13)**	**0.002**	**1.80 (1.39–2.34)**	**< 0.001**
Content that causes appearance pressures (ref. never)						
Daily	**5.12 (3.39–7.74)**	**< 0.001**	**8.89 (6.21–12.73)**	**< 0.001**	**6.96 (4.85–9.97)**	**< 0.001**
Weekly	**2.14 (1.48–3.10)**	**< 0.001**	**3.32 (2.46–4.48)**	**< 0.001**	**4.94 (3.72–6.55)**	**< 0.001**
Monthly	0.98 (0.61–1.57)	0.925	**1.65 (1.17–2.33)**	**0.004**	**2.02 (1.50–2.73)**	**< 0.001**

Fixed-effect multinomial logistic regression models: odds ratios (OR); 95% confidence intervals (CI); *ref.* reference category

The significance level was set at $p < 0.05$. The significant associations have been **bolded**

Regression models for each social media threat were run separately. Health outcomes were treated as outcome variables in the models

The models were adjusted for gender, age, FAS

exposure to seven out of the nine social media threats (e.g., cyberbullying, racism, phishing attempts).

Based on suggestions by scholars [15, 54] we studied adolescents' social media threats through a developmental lens and found older adolescents (13- and 15-year-olds) to be more likely than 11-year-olds to encounter social media threats, daily, weekly, and monthly (with some exceptions). One reason for this could be that older adolescents have had more years to experiment with social media, and they use social media more intensively [92, 94].

We further hypothesized that individual (e.g., emotional intelligence) and social (e.g., family support) factors could protect adolescents from encountering social media threats (H2.1). Our findings showed that these factors do indeed have a potential to mitigate adolescent exposure to social media threats. For example, a higher level of *emotional intelligence* was linked to less likely

daily exposure to cyberbullying, sexual harassment, and phishing attempts, thus highlighting the importance of emotional skills as a protection against social media threats. A similar notion could apply to the role of *family support*, since a higher level of family support was negatively associated with daily and weekly exposure to all other social media threats, apart from misinformation. The promotion of supportive parent-child relationships, as opposed to the adoption of overly restrictive parental monitoring strategies, could encourage adolescent disclosure, and thus lead to more positive outcomes [106].

The role of *friend support* on social media threats was more complex and it varied across the social media threats. On the one hand, higher friend support was positively associated with daily exposure to the sale and distribution of drugs. On the other hand, higher friend support had a negative association with daily exposure to cyberbullying. Previous literature indicates that the social media context may amplify peer influence processes, which affect adolescent behaviours and cognitions [41]. As an example, in adolescence, peer groups are approached and valued to a significant degree, and through drug-related behaviour adolescents may try to connect with deviant peers and enhance their social status [42]. However, the same friendships that amplify adolescent risk behaviour through social media may simultaneously work as a barrier against other threats such as cyberbullying [75].

It was also hypothesized that certain factors describing how adolescents use social media (notably PSMU and intensive online communication with strangers), were among the factors placing adolescents in a vulnerable situation regarding social media threats (H2.2). Adolescents with PSMU and those reporting intensive communication with strangers, were in fact more likely to report daily exposure to every social media threat, with the exception of misinformation. Similarly, there was support for the claim that vulnerabilities tend to beget vulnerabilities [see 6] including in the digital environment (involving the co-occurrence of PSMU and social media threats). Furthermore, although previous research has shown social media solicitation (i.e., approaching young people with ill intentions) to be rare, our results show that adolescents engaging in intensive communication with strangers are at greater risk of encountering various threats. Adolescents should thus be provided with the knowledge and skills to operate with people they do not know, and identify malicious intents on social media.

Exposure to various social media threats was further expected to explain negative health among adolescents, with the associations varying between different social media threats and the prevalence of the exposure (H3). This study showed that daily and weekly exposure to social media threats was systematically associated with poor self-rated health, and with frequent depressive feelings and anxiety symptoms (thus confirming our third hypothesis). Moreover, exposure to any of the nine social media threats as seldom as once a month increased the likelihood of at least one negative health outcome. There were also threats (notably cyberbullying and sexual harassment) to which monthly exposure increased the likelihood of all the studied negative health outcomes. In general terms, the odds ratios for experiencing negative mental health increased when the frequency of exposure to social media threats increased. For instance, monthly exposure to harmful social media challenges increased the likelihood of frequent depressive feelings by 59%, whereas daily exposure to such challenges increased the likelihood by 318% as compared to those who were never exposed to harmful challenges. Such findings are consistent with previous research indicating increased exposure to online risk as a contributor to negative health outcomes [107, 108].

However, exceptions also emerged. For example, the association between exposure to cyberbullying and poor self-rated health was strongest among those who reported bullying weekly as opposed to daily. Such findings may have to do with the type of bullying (i.e., which form has the most severe health effect) [109], and whether those who self-report daily cyberbullying experience less severe forms of aggressive online behaviour, and hence less severe consequences for health. Consequently, more nuanced research is needed, given that substantial within-threat variation could exist in the social media threats explored.

The associations between social media threats and negative health among adolescents raise important questions from an intervention and policy-making perspective, regarding how threats should be prioritized, and at which threats limited resources should be targeted. For example, researchers [14] have identified misinformation as a clear public health challenge, especially due to the co-occurrence of persistent health disparities– yet, as discussed above, social media threats should not be evaluated purely by the prevalence of exposure. In this regard, it is worth noting that while 79.5% of adolescents had never encountered cyberbullying and 77.7% had never encountered sexual harassment, even one encounter with such a situation could be detrimental to adolescent health. This is especially the case, insofar as this and previous studies have systematically shown an association between such threats and negative health indicators [9, 110].

Strengths and limitations

The present study had several strengths, including a large-scale nationally representative sample of adolescents and the use of validated instruments, plus a

carefully considered distinction between different social media threats. Furthermore, to our knowledge, this is the first study to provide evidence on the association between PSMU and several other threats (e.g., harmful social media challenges), thus, opening up novel horizons for future studies and interventions. However, the findings should be interpreted with several limitations in mind. Firstly, the study's cross-sectional design does not allow causal inferences. Secondly, it can be argued that self-reporting instruments may not give an objective view of adolescent exposure to social media threats, and that self-reporting measures of media experiences may not be a legitimate substitute for more objective measures [111]. For example, in terms of cyberbullying, the power imbalance between the perpetrator and the victim cannot be precisely measured via the type of self-reporting instrument used in this study. For instance, researchers argue that power might behave differently in the online context and that power dynamics can manifest through technological proficiency or possession of harmful content [112, 113]. Hence, it could be interpreted that any individual who can exploit technology to harm others holds a position of power, at least temporarily, in relation to the victim of the assault [113]. Similarly, self-reporting instruments may not provide an objective reflection of certain individual and social factors, given that not all individuals will necessarily perceive, for instance, emotional intelligence in the same way. However, the information given by self-reporting instruments is necessary if one is to explore individuals' personal experiences and views [114] on their emotional intelligence. One must also bear in mind that experiences of social media threat exposure are individual and subjective (as in the case of cyberbullying); hence, they need to be investigated via measures considering individual experiences (as in this study). Nonetheless, the information could have been enriched by the views of multiple informants, including peers, parents, or teachers.

Finally, one must be cautious about generalizing the results beyond the study populations (e.g., to non-white, and low-income countries). To overcome these limitations, future studies should employ cross-national study settings, wider study populations, and longitudinal research. Furthermore, moderation and mediation approaches could be applied to better understand (i) the factors protecting against social media threats, and (ii) how social media threats operate in the association between the intensity of social media use and health, and in the associations between various social media activities and health outcomes. There is also a need to investigate how social media threats co-occur and interrelate, for example, whether being exposed to one social media threat increases the likelihood of being exposed to many. One could also seek to determine whether certain types of threats accumulate for specific individuals, and how the individuals themselves act or react (e.g., as regards cyberbullying perpetration, sexual harassment perpetration, and the sharing of misinformation) on social media. Person-oriented approaches such as Latent Class Analysis (LCA) would be advisable in this regard.

Conclusions

Our study indicates that intervention and health promotion efforts are needed to reduce adolescent exposure to social media threats and associated negative health outcomes. The efforts should consider the individual and social differences among adolescents (the aim being to promote equity by ensuring that adolescents in vulnerable situations benefit proportionately more from such efforts) [see 105]. The measures taken could aim to support resources such as emotional intelligence and family support against social media threats. Furthermore, we suggest that, in particular, governments and service providers should act and collaborate to reduce adolescent encounters with social media threats. The negative impacts of social media threats on health could be mitigated by directing resources to vulnerable populations, utilizing both algorithmic strategies and caregiver interventions [115]. Additionally, the use of advanced technologies such as natural language processing and data mining can aid in identifying and removing online content that is harmful, provocative, or lacking scientific validity [115]. It is also important to keep in mind the positive aspects of social media use, including the increased opportunities it allows for social connection [5]. Altogether, efforts to ensure safe social media for adolescents are crucial, as highlighted also by the development strategies undertaken in Europe [24, 25].

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Author contributions

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Availability of data and materials
The dataset supporting the conclusions of this article will be available in the HBSC Data Management Centre repository: https://www.uib.no/en/hbscdata/113290/open-access. The 2022 data will be made available in 2026 according to the HBSC protocol. The analysis path and the code will be made available in OSF: https://osf.io/ upon acceptance of the manuscript.

Declarations

Ethics approval and consent to participate
The Ethical Committee of the University of Jyväskylä approved the survey.

Competing interests
The authors declare no competing interests.

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