REVIEW TITLE: Does social media influence adolescent engagement in health risk behaviours? A protocol for a systematic review and meta-analysis

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Author contributions

The review idea was conceived by AKP and SVK. AKP conducted an initial scoping search of the literature, subsequently AKP, SVK, AP and MH produced an analysis plan for the review. The first draft of the protocol was written by AKP and co-authors provided feedback. AKP acts as the guarantor of this review. Kirsty Blenkins, Lee Craig, Neil Coles, Nicholas Hickmott, Professor John Holmes, Rachel Macpherson and Dr. Ross Whitehead provided additional guidance and feedback on the protocol, and Valerie Wells (information scientist) assisted in the development of the search strategy, for which the authors wish to express their gratitude.

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BACKGROUND

The incidence of health risk taking behaviours such as drug-use, anti-social behaviour and unprotected sex, rise sharply during the period of adolescence and often co-occur during this period.[1,2,3–5] Globally, unsafe sex (4% of disability-adjusted life-years (DALYs)), alcohol use (7%), and illicit drug use (2%), are major risk factors for DALYs lost amongst adolescents.[6] The burden of disease, mortality and social impacts associated with engagement in multiple health risk behaviours (e.g., presence of two or more health risk behaviours) is likely to be markedly higher.[5,7] A considerable amount of research has been devoted to understanding what places adolescents at risk of engaging in these behaviours. One area yet to be fully explored, is the role of social media, and how time spent on social media, the type of social media used, and the type of health risk behaviour content viewed online may be influencing adolescent engagement in health risk behaviours.

Use of social media globally is growing with over 3 billion users worldwide, representing 45% of the world's population, and an increase of 280 million users since 2018.[8] Approximately one seventh of the world's population are identified as regular users,[9] and adolescents, defined as those aged 10-19 years,[10] are the most active.[11] Within the United States 93-97% of adolescents use at least one social media platform and on average use social media platforms for nearly 3 hours each day.[12,13] Similarly, in the UK 91% of adolescents use social media,[14] and on average use social media platforms for just over two hours per day.[15] The diversity of social media, and its inherently social nature, underpins its appeal to younger generations.[16] Age, gender, education, ethnicity, income, competence using computer-mediated communication and socioeconomic position influence which adolescents use social media, which social media platforms they use, and the time spent on these.[17,18,19,20,21] Relatively few formal definitions of social media exist, due to its nascent and still evolving nature.[22] Those definitions which exist agree it encompasses three main themes: what social media does (facilitates communication and collaboration and the creation, modification and sharing of content); how it enables these activities (through web-based services and applications); and the type of content it contains (e.g., user-generated, marketer-generated).[23, 22]

Social media can be a useful easily accessible source of health information and education for adolescents, although the credibility and trustworthiness of the information may be lacking.[24] Due to the anonymity of the internet, adolescents feel more comfortable searching for sensitive health topics like sexually transmitted infections (STIs) on social media, are likely to be influenced by the information identified online, and report a change in behaviour as a result.[24] Equally, social media provides new opportunities for exposure to health risk behaviours, including alcohol, tobacco and drug use, antisocial behaviour, sexual health risk behaviours, inadequate physical activity and unhealthy dietary behaviours, and more recently gambling and use of electronic nicotine delivery systems (ENDS), all of which are portrayed regularly on digital media.[1,16,25,26,27]

Adolescent and peer posts on social media, considered user-generated content, may portray health risk behaviours including alcohol, other substances and sexual behaviours.[28,29,30] During adolescence, sensation seeking increases abruptly, more so in the presence of peers.[2,31] This heightened sensitivity to peers has arguably been intensified by social media which presents the potential to change the very notion of the peer group and the extent and accessibility of sociocultural norms surrounding risk behaviours, which may further contribute to adolescent experimentation with risk behaviours.[32] It is not surprising that adolescents might copy health risk behaviours from social media, with viewing health risk behaviours online linked to health risk behaviours offline in both experimental and longitudinal research.[33,34,35] Adolescents are also exposed to marketer-generated content (e.g., advertising) which can promote engagement in health risk behaviours.[36] Longitudinal research has identified alcohol related marketing as predictive of actual alcohol consumption in college students[37] and adolescents.[38,39] This synthesis of media and peer influences has the potential to contribute to an adolescent's perceived social norms about health risk behaviours and therefore their

behaviours, as proposed by the Facebook Influence Model which suggests social media content amplifies peer influence processes which consequently affects cognition and behaviour.[40,41]

A limitation of the existing evidence is that it is heterogenous, and the vast majority of research fails to account for adolescent developmental change over time, direction of effects or infer any conclusions regarding causality.[16,42,43] Furthermore, despite widespread recognition that adolescence is the highest risk period for initiation of health risk behaviours and that social media exposure commences during childhood and increases as children move into adolescence,[41,44] the majority of existing reviews focus on college/university populations.[42,43] It is plausible that a bidirectional relationship exists. Uses and gratification theories,[45] suggest adolescents who are more inclined to engage in risky behaviours, may feel the need to present their risky behaviours online to attain positive feedback and approval from peers.[45,46] There is also limited evidence that social media's influence on adolescent health risk behaviours may vary by population subgroup, including socioeconomic position, gender, age and between high and low-middle income countries.[35,47,48] Due to the lack of a consistently applied definition for social media, a further limitation is the absence of a systematic categorisation scheme which outlines the measures for assessing social media use in relation to adolescent engagement in health risk behaviours. As the number of types of social media platforms increases (see Appendix 1), it is likely that the extent of use and the time spent on them changes and therefore influences the nature of peer interactivity and content exposure, which consequently can influence health rated norms and behaviours.[25]

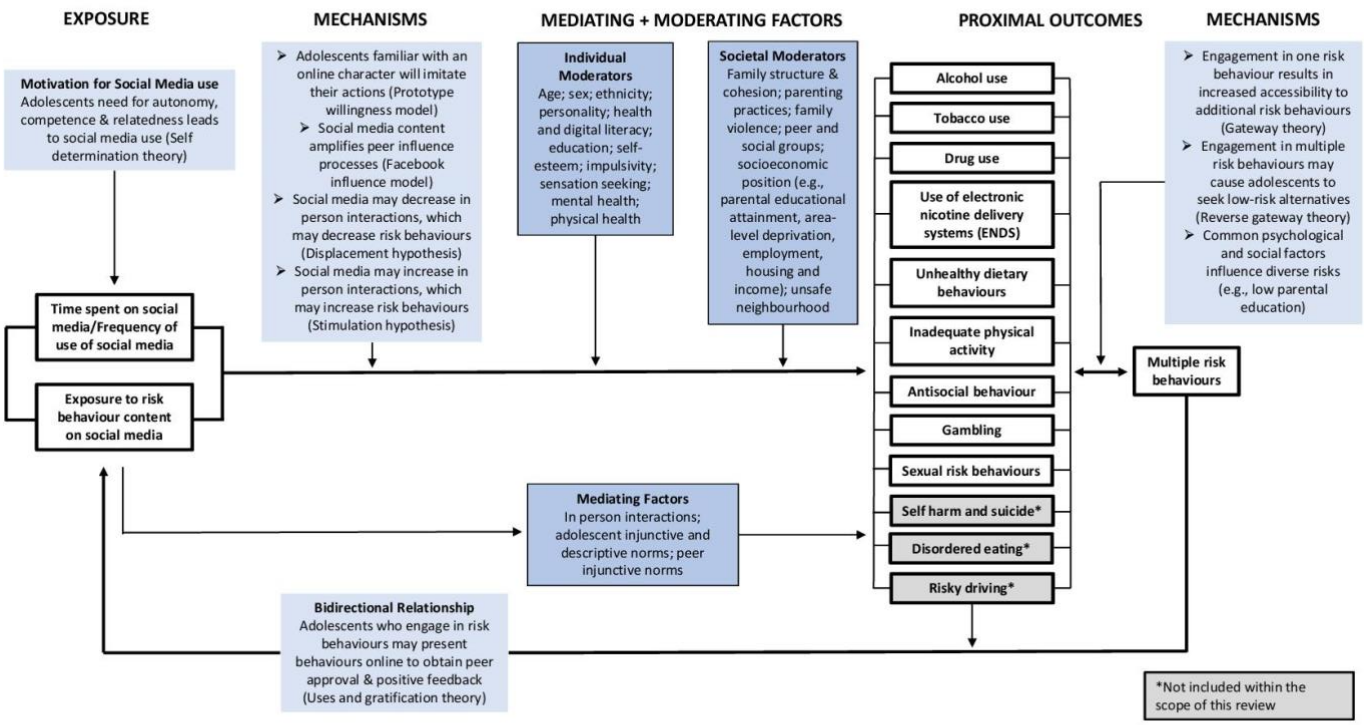
One existing meta-analysis identified moderate positive correlations between exposure to alcohol related social media content and alcohol consumption (r = 0.36, 95% CI: 0.29 to 0.44) and alcohol related problems (r = 0.37, 95% CI: 0.21 to 0.51) in adolescents and young adults.[42] This review did not distinguish between user and marketer-generated content and did not assess the risk of bias of included studies, which is necessary to identify the most robust evidence.[49] A narrative systematic review, found Facebook use was associated with increased alcohol use in the general population.[43] A more recent meta-analysis,[50] revealed small to medium, positive correlations between general social media use and substance use (r= 0.19, 95% CI = 0.12-0.26) and risky sexual behaviours (r= 0.21, 95%CI = 0.15-0.28) in adolescents, but again the review authors failed to assess the risk of bias of included studies.[50] A small, positive association was found in another meta-analysis, between exposure to sexually explicit websites and having sexual intercourse without a condom, in adolescents (OR 1.23, 95% CI: 1.08-1.38).[51] Yet this, meta-analysis was not restricted to social media use and considered all forms of digital media.

Given the lack of clear cut evidence regarding the relationship between social media and adolescent health risk behaviours, the aim of the current review is to investigate the relationship between social media and adolescent health risk behaviours, defined as alcohol, tobacco, drug use, use of ENDS, unhealthy dietary behaviours, inadequate physical activity, antisocial behaviours, gambling, sexual risk behaviours and multiple health risk behaviours. To address the limitations of previous reviews, several characteristics of social media will be considered including the social media assessment measures currently adopted in the existing evidence base, more specifically, time spent on social media/frequency of use of social media, type of social media used and exposure to health risk behaviour content on social media. Second, a rigorous assessment of the risk of bias of included studies will be conducted, alongside an assessment of the methodological quality of the evidence. Finally, it is hoped that this review will capture the methodological improvements in study design, and measurement of social media observed in recent years in the social media literature. Such a review could help to inform policymakers seeking to protect or promote the health and development of the adolescent population.

Logic Model

Logic models can be used to direct the systematic review process, more so when the mechanisms between an exposure and outcomes are predicted to be complex.[52] A logic model can assist in refining the review questions, identifying relevant inclusion/exclusion criteria, justifying the need for subgroup analyses and ensure the review is relevant to both policy and practice.[52,53] The completed logic model should demonstrate hypotheses for how the exposure will work and how external factors may interact with the hypothesised mechanism of action. Based on a scoping of relevant literature, advice from both subject experts and the advisory committee, a logic model was developed for this review (Figure 1).

Figure 1: Logic model illustrating theory of change for social media and adolescent health risk behaviours



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Aim of Review

This systematic review will aim to evaluate the association between social media and adolescent health risk behaviours.

Review objectives

1) To explore how social media use is measured in relation to adolescent health risk behaviours.
2) To investigate the association between time spent on social media/frequency of use of social media and adolescent health risk behaviours.
3) To explore the association between exposure to health risk behaviour content on social media and adolescent health risk behaviours and investigate if the type of health risk behaviour content viewed on social media (e.g., user-generated, marketer-generated) affects the relationship between social media and adolescent health risk behaviours.
4) To investigate if the various types of social media used (e.g., general social media use, use of social networking sites) affects the relationship between social media and adolescent health risk behaviours.
5) To assess if the association between social media and adolescent health risk behaviours differs by population subgroups (namely gender, age and socioeconomic position).
6) To assess if the association between social media and adolescent health risk behaviours differs between high-income countries and low/middle-income countries.

RELEVANT GUIDELINES FOR STUDY CONDUCT AND REPORTING

The review will be conducted and reported in accordance with PRISMA statement guidance (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)[54] and, if meta-analysis can be undertaken, MOOSE (Meta-analysis of Observational Studies in Epidemiology) guidance.[55] For data where meta-analysis is not suitable, the Synthesis Without Meta-Analysis (SWiM) in Systematic Reviews guidance will be employed.[56] To assess the certainty of evidence, we will follow the guidance of the Grading of Recommendations Assessment, Development and Evaluation (GRADE) Working Group.[57] This protocol has been produced according to the PRISMA-P 2015 checklist of recommended items to include in a systematic review protocol.[58]

INCLUSION CRITERIA

Table 1: PECOS criteria

P (Population)	Adolescents (aged 10-19 years)
E (Exposure(s))	Social media are "websites and applications that allow users to create and share content or to participate in social networking".[59] This content can be in the form of messages, status updates, news, data, advertisements, images, video content, audio and comments etc. Social media categorisations include social networking sites; microblogging sites; blogs and forums and media sharing sites.[22] Appendix 1 outlines the ten main types of social media, all of which will be considered for inclusion within this review, alongside examples and definitions of each.
C (Comparison)	Those individuals with no or differing levels of social media use.
O (Outcome(s))	Adolescent health risk behaviours, considered as alcohol use, tobacco use, drug use, use of electronic nicotine delivery systems (ENDS), unhealthy dietary behaviours, inadequate physical activity, antisocial behaviour, gambling, sexual risk behaviours and multiple risk behaviours.
S (Study type)	Observational quantitative study designs, to include cross sectional studies; cohort studies; case control studies; longitudinal studies; natural experiment studies. Baseline data from intervention studies and data obtained from any quantitative analysis conducted within mixed method studies. Eligible studies are required to have enough quantitative information to calculate effect sizes.

Population

This review will include studies examining the adolescent population (ages 10-19 years) from any country. The precise age range adolescence encompasses is debatable, however it is agreed that during this period young people experience rapid physical and cognitive growth, experience puberty, and transition from the relative security of childhood to confront a number of social and life challenges as well as unprecedented social factors such as digital media.[60] The United Nations formally recognises adolescence as the period between 10 and 19 years of age.[61] Similarly, the World Health Organisation (WHO) distinguishes the stages of adolescent development into early(10-15 years), middle(14-17 years) and late adolescence(16-19 years).[10] Therefore, this review will consider studies, in which the majority of the study population falls between 10 and 19 years.

Exposure(s)

This review will include studies which evaluate the effects of social media use. Social media use will consider all types of social media (see Appendix 1 which outlines the main types of social media) as well as all quantitative measures of social media use reported within included studies. In including all quantitative variable assessment measures of social media use, it is anticipated this will facilitate classification of the various measures of social media use. Studies will be considered for inclusion if they include at least one measure of social media use. All methods of measurement for social media use, including self-report and objective measures of social media usage tracked by mobile phones or other electronic devices will be eligible for inclusion. Studies which examine social media use related to individual or group interventions (e.g., particular school prevention programme or behaviour change programme), will be excluded. However, baseline data from these studies will be considered for inclusion.

Modifier(s)

Based on the existing evidence, it is anticipated that a number of factors may modify the relationship between exposure and outcome, including:

- Type of health risk behaviour content viewed on social media (e.g., user-generated content, marketer-generated content)
- Type of social media used (e.g., general social media use, use of social networking sites)
- Age of study participants
- Gender of study participants
- Socioeconomic position of exposed population
- Development status of country of exposed population (e.g., high vs low-and middle-income country settings, as classified by the World Bank 2017 classification)

Should the data permit, we plan to perform subgroup analysis/meta-regression according to the exposure groupings cited above. Due to the evolving nature of social media research, there may be additional content subgroups identified within both user-generated and marketer-generated content. Data permitting, additional subgroup analyses/meta-regression may be performed to investigate the potential moderating effect of these content subgroups.

Comparison

The comparator group will be those individuals with no or differing levels of social media use. Within observational studies, the comparator group may be another subgroup of the sample who have lower or higher levels of reported social media use.

Outcome(s)

Outcome selection was guided by preliminary evidence,[62] those health risk behaviours which contribute to the leading cause of death and disability among youth and adolescents, as indicated by the Centers for Disease Control and Prevention,[63] the logic model and following discussion and completion of an online survey with advisory group members. All pre-selected outcomes on average achieved 'critical' or 'important' ratings in line with the GRADE approach.[57] Detailed information on the involvement of the advisory group is provided under the heading 'Advisory Group'.

The primary outcomes, definitions and illustrative examples of outcome measures are listed in table 2.

Table 2: Summary of outcomes

Primary Outcome(s)	Review definition	Examples of outcome measures
Alcohol use	The drinking of beverages containing ethyl alcohol.[64]	Ever drank alcohol Frequency of alcohol use Problem/binge drinking Heavy/hazardous drinking
Tobacco use	The practice of smoking tobacco and inhaling tobacco smoke.[65]	Ever smoked a cigarette Frequency of tobacco use
Drug use	Use of drugs for psychotropic rather than medical purposes, potentially including both legal and illegal substances.[66]	Illicit drug use Cannabis use Illicit drug use (other than cannabis)
Electronic Nicotine Delivery System (ENDS)	An umbrella term for several products including vapes, vaporizers, vape pens, e-cigarettes and e-pipes. ENDS are non-combustible tobacco products and use an e-liquid which contains nicotine, and varying compositions of flavourings, vegetable glycerine, propylene glycol and other ingredients. The liquid is heated to produce an aerosol the user inhales. All ENDS contain nicotine but Electronic Non-Nicotine Delivery Systems (ENNDS) do not.[67]	Ever tried an e-cigarette Frequency of e-cigarette use
Unhealthy dietary behaviours	Umbrella terms referring to all phenomena related to food choice, eating behaviour, and dietary intake/nutrition.[68] Disordered eating will not be considered.	Low level of fruit and vegetable consumption High-fat diet High-sugar diet High-salt diet Low-fibre diet
Inadequate physical activity	Doing no or very little physical activity at work, at home, for transport or in discretionary time.[69]	Physically active for less than 60 minutes per day on fewer than 5 days a week Low levels of physical activity
Antisocial behaviour	Any action which violates social norms in ways which reflect disregard for others or which reflect the violation of another's rights.[64]	Violence Criminal damage Aggregated assault Sexual assault Assault with or without injury Hitting a parent, teacher or student Racist abuse

		Burglary/breaking and entering Stealing/theft Joy-riding Carrying a weapon Exhibiting disorderly conduct Graffiti/vandalism Vehicle-related theft
Gambling	Placing something of value (usually but not always money) at risk in hope of acquiring something of greater value.[70]	Regular gambling Uncontrolled gambling
Sexual risk behaviours	Initiation of sexual activity at an early age, engaging in unnatural (anal/oral) or unprotected sexual intercourse (or inconsistent condom use), having sexual intercourse with multiple partners (protected/unprotected), engaging in paid or irregular or incentive-driven sex or sexual intercourse with an injecting drug user or under the influence (especially intoxication) of psychoactive substances, which may result in sexually transmitted infections (including HIV/AIDS), unintended/early pregnancies (or abortions), or legal or interpersonal conflicts.[71]	Early age of sexual debut Sex in exchange of gifts/money Unprotected sexual intercourse Sexual intercourse with multiple partners Posting, sharing or exchanging sexual content using electronic devices
Multiple risk behaviours	Two or more of the above primary outcomes.	

We will focus on the use of Electronic nicotine delivery systems (ENDS) and will make efforts to differentiate between ENDS and Electronic non-nicotine delivery systems (ENNDS) in the studies we review. Where observational studies of a longitudinal nature report outcome data at multiple time points, exploring change over time, these will be extracted separately to facilitate potential sensitivity analysis to explore any differences by study design. All measurement methods of outcomes will be considered for inclusion, including self-report, online activity, text messages, reports from physicians, other professionals, parents, guardians and peers, physiological measures of substance use, medical diagnoses (e.g., STIs, HIV), records of truancy and school exclusion for health risk behaviours, or of criminal activity or arrests for risky behaviours. We provisionally plan to record adjusted estimates for data extraction purposes, however if unavailable, unadjusted estimates will be recorded. Efforts will be made to record which potential confounders have been adjusted for. Additional sensitivity analysis is planned excluding any data points where unadjusted estimates have been reported.

Study type and characteristics

Quantitative study designs examining the association between exposure on the outcome(s) of interest will be eligible for inclusion. Peer reviewed studies reporting primary research, preprints and baseline data from intervention studies will be considered for inclusion. Quantitative data from mixed method studies will be included, but qualitative studies will be excluded.

Only those studies published in English-language, from the 1st January 1997 will be considered for inclusion. The date range specified will ensure the retrieval of all relevant articles since the first recognisable social media site, 'Six Degrees' was launched in 1997. No geographical location limits will be applied.

EXCLUSION CRITERIA

Table 3: Detail of exclusion criteria

1.	Incorrect population	Studies examining college or university students will be excluded as they have different levels of exposure and access to social media and health risk behaviours compared to adolescents.[41,44] If these additional population groups are included in a study alongside the population of interest, during full text screening efforts will be made to determine whether any relevant data can be extracted.
2.	Incorrect exposure	a) Studies examining internet/computer/media activities, other than social media will be excluded. Where these additional exposure groups are included in a study alongside the exposure of interest (social media), efforts will be made at full text screening to determine if any meaningful data can be extracted; b) Studies which examine social media use related to individual or group interventions (e.g., particular school prevention programme or behaviour change programme), will be excluded. However, baseline data from these studies will be considered for inclusion; c) Studies which examine social media as a recruitment method will be excluded; d) Studies which examine problematic use of social media will be excluded.
3.	Incorrect outcome	a) Studies investigating lack of sleep,[72] eating disorders,[73] self-harm,[74,75] suicide,[76,77] will be excluded due to their previous examination in existing or ongoing reviews. Should these studies examine one or more of the primary outcomes they will be considered for inclusion, if relevant data can be extracted.
4.	Incorrect comparator group	Studies which do not report on differing levels of social media use will be excluded.
5.	Incorrect study type	a) Qualitative studies will be excluded; b) Commentary, editorial, non-systematic review articles and conference abstracts will be excluded; c) Systematic reviews will be excluded; however, their citations will be screened to identify potentially eligible studies for inclusion.
6.	Incorrect language	Studies not reported in the English language will be excluded.
7.	Incorrect unit of analysis	Studies which do not report data on exposure at an individual level will be excluded (e.g., ecological studies).

SEARCH METHODS FOR IDENTIFICATION OF STUDIES

Electronic databases

We will search the following five bibliographic databases from the period 1st January 1997:

- Cumulative Index to Nursing and Allied Health Literature (CINAHL) via EBSCO
- Embase via OvidSP
- Medical Literature Analysis and Retrieval System Online (MEDLINE) via OvidSP
- PsycINFO via OvidSP
- SocIndex via EBSCO

Terms

An initial scoping search with no restrictions or limits was conducted using a combination of free-text search terms. Returned search results were screened to identify potentially relevant subject headings, free-text terms and phrases. The

final search strategies were constructed from combinations of MeSH and keywords/free-text terms, and will be modified to fit the syntax of each database.[78] An information specialist assisted in the development of the search strategy. The search strategy for the Embase database is presented in Appendix 2. In order to maximise the sensitivity of the literature search, filters for study types will not be used.[49(section 24.3.2)] This review will only consider English language studies for inclusion, however no language restrictions/limits will be applied to the search, to ensure all potentially relevant studies are identified and establish the potential implications of language exclusions.

Searching other resources

As social media research constitutes a fast-moving field, as advised by the information scientist, and subject experts, using the same criteria adopted within the electronic database searches where possible, preprint repositories will also be consulted, and will be included in the systematic review if eligible and appropriate, in order to minimise bias.[49(section 4.3.2)]

We will search the following preprint repositories:

- Social Science Research Network (SSRN e-library)
- SocArXic Preprints
- PsyArXiv Preprints
- MedRxiv Preprints

Experts in the field of social media and adolescent health will be contacted to ensure retrieval of all relevant studies and to identify any ongoing or unpublished studies. Awareness of potentially relevant ongoing studies will inform decisions regarding expected completion date of the review.[49(section 4.3.2)] Information about relevant ongoing studies will be included in the review within the 'Characteristics of ongoing studies table'. The reference lists of all included studies and relevant systematic reviews will be searched by hand.

Internet search engines

Using a set of terms employed from the search of academic and grey literature databases, the first 30 hits in Google Scholar will be screened.

ADVISORY GROUP

We established an advisory group of experts and policy makers in the field of social media and adolescent health risk behaviours to provide advice and suggestions to inform this review at protocol and review stages. The review advisory group members include policy makers, researchers, non-governmental organisation experts and academics. In line with the GRADE approach, the advisory group members were asked to rank pre-selected outcomes according to their relative importance on a 9-point Likert scale(categories: 1-3 – of limited importance; 4 to 6- importance; 7 to 9- critical).[57] This was completed via means of an online survey.

The review advisory group members were provided with detailed background information on this review. At the protocol stage, group members were requested to provide feedback on several factors including the relevance of the review's question, population focus, search strategy, ongoing or published studies, and grey literature selection.[49(section 2.4.2)]. Feedback was received during in person meetings, Skype/Zoom or via email. Details of members of the advisory group and results of the online survey are presented in Appendix 3 and 4.

DATA COLLECTION AND ANALYSIS

For the review a reference library will be created and maintained in Mendeley reference manager. Covidence will be used during the search and screening process to manage records, and Excel will be used for data extraction.

Selection of studies

Following initial de-duplication in Mendeley, search results will be imported into Covidence and de-duplicated automatically using title, authors, year of publication, and journal. PECOS eligibility criteria will be added to the 'Criteria' section within Covidence, to standardise the study selection process, and piloted on 100 studies to help refine the eligibility criteria, train those who will be applying the criteria and to ensure the criteria can be consistently applied by more than one individual. As a single failed eligibility criterion is considered sufficient to warrant exclusion from the review, the eligibility criteria will be assessed in order or importance, commencing with the presence of the exposure of interest. If the exposure is not present, this first 'no' response will be used as the primary reason for the studies exclusion and the remaining criteria need not be assessed.[49(section 4.6.4)] Firstly, on the basis of titles and abstracts, all retrieved studies will be screened independently by the lead reviewer (AKP) and by a second reviewer to identify studies which can be readily excluded. If an abstract is not accessible via the database it originates from, however the title appears to be relevant, the record will be passed to the full-text review stage. Through discussion, conflicts regarding eligibility for inclusion will be resolved, where there is disagreement the opinion of a third author will be sought to achieve consensus. Full-text versions will then be screened by the lead reviewer (AKP) and a second reviewer. The two authors will compare their list of relevant studies and in the case of disagreement, the opinion of a third author will be sought.

Where systematic reviews are identified, efforts will be made to retrieve, screen and include the original studies. If it is not possible to obtain the full text of a potentially eligibly study reported in a systematic review, the data presented in the review will be extracted. As it will not be possible to translate non-English language reports of studies, due to both time and resource constraints, potentially relevant non-English language studies will be filed as "Potentially Relevant Non-English" rather than "Excluded studies" to make readers of the review aware of the availability of other potentially relevant reports. This will be reflected within the PRISMA flow diagram as "Potentially Relevant Non-English".[49(section 4.4.5)] To identify duplicate data from studies presented in separate publications, studies will be reviewed. If this does occur, the study with the largest or most representative sample size will be included. If these are also similar, the more recent study will be included. Where uncertainties still remain, efforts will be made to correspond with the study authors for further clarification.[49(section 4.6.2)]

A PRISMA flow diagram will be used to depict the selection process.[54]

Data extraction and management

Data extraction will be performed by the lead reviewer (AKP) and by a second reviewer using a standardised form. Ten percent of data extraction will be performed independently by both the lead reviewer (AKP) and by the second reviewer. Results from each reviewer will then be cross checked. The remaining ninety percent will be conducted independently by the lead reviewer (AKP) and will be checked independently by the second reviewer. Disagreements will be resolved by a third reviewer. We will extract general information (publication type, country of study, funding source for study, potential conflict of interest), study eligibility (type of study, participants, type of exposure, and type of outcome measures), study details (study aim, methods, results, confounders, and confounder adjusted and/or unadjusted outcomes) as well as other relevant information. Prior to data extraction, the form will be piloted within the review team on a sample of five studies to assess its usability and to allow any amendments to be made.[49(section 5.4.1)] Where relevant data appear to have been collected as stated within included studies, but are not sufficiently reported for data extraction purposes, study investigators will be contacted to request these.

ASSESSMENT OF RISK OF BIAS (ROB) OF INCLUDED STUDIES

Based on an initial scoping search of the literature, it is anticipated that the majority of included studies will be non-randomised or observational studies, including natural experiment studies. All included studies will undergo independent quality assessment by two reviewers, using the Newcastle-Ottawa Scale for assessing risk of bias in non-randomised studies.[79] A modified version of the Newcastle-Ottawa scale will be used for cross-sectional studies.[80] Should there be any disagreements, discrepancies will be discussed with a third author and resolved by consensus. Those studies reporting baseline data from an interventional study will be appraised as per cross-sectional studies. Risk of bias assessment will be conducted at the outcome level. The RoB assessments will inform both the data synthesis and certainty assessment, which will be assessed using the GRADE system.[57] High risk of bias studies will not be excluded; instead, the results of all included studies will be reported. Sensitivity analysis of studies at low risk of bias will be conducted.

An initial scoping search of the literature and discussion with the review team, assisted in the identification of confounders and co-exposures, presented below.

Confounding factors relevant to all or most studies

- Age
- Sex
- Ethnicity
- Measures of socioeconomic position (e.g., parental educational attainment, area-level deprivation, employment, housing, tenure, income)

Co-exposures

- School connectedness and activities (e.g., exposure to digital and health literacy interventions)
- Policies on regulation of social media content and screen time (e.g., screen time guidelines, restrictions on posting of online harmful content)

DATA SYNTHESIS

Based on an initial scope of the literature, we anticipate outcome domains will include alcohol use, tobacco use, drug use, use of ENDS, unhealthy dietary behaviours, inadequate physical activity, antisocial behaviours, gambling, sexual health risk behaviours and multiple risk behaviours. Potential data synthesis methods include the use of synthesis without meta-analysis (SWiM) and meta-analysis. For primary analyses, we anticipate meta-analysis will be used.

Firstly, the characteristics of included studies, including study year, design, social media measure, geographical distribution, number of participants and reported outcomes will be summarised in tabular format. All social media measures reported in included studies in relation to adolescent health risk behaviours, will then be summarised in narrative format to facilitate the creation of a classification scheme of social media measures.

Synthesis without meta-analysis (SWiM)

Effect estimates from included studies will be converted to a common metric. We will attempt to convert dichotomous outcomes to odds ratios (ORs) or relative risks (RRs). If data allows RRs will be the preferred effect measure, however if data points do not provide sufficient information for RRs to be calculated ORs will be used. Continuous outcomes comparing categorical exposure groups will be expressed as standardised mean differences. For continuous outcomes comparing continuous exposure measures, data permitting, estimates will be converted to standardised regression coefficients or correlations. In ensuring independence of data only one effect size per outcome from each study will be used in each meta-analysis. Should study authors report multiple measures of the same behaviour (e.g. weekly alcohol consumption,

frequency of binge drinking) all data will be extracted, and the most commonly used outcome will be selected as the main outcome measure.

Where effect estimates are incompletely reported or where study characteristics such as study design, exposures or outcomes are too diverse to provide a meaningful summary effect estimate, alternative presentation and synthesis methods can be adopted to provide a useful summary of the evidence for decision-makers.[81] It is expected that there will exist a degree of statistical heterogeneity across included studies and differences in classification and reporting of effect estimates. Therefore, we anticipate that elements of SWiM will be incorporated within this review, such as vote counting based on direction of effect, combining P values or summarising effect estimates, in conjunction with the RoB assessments for each included study.[81] If a standardised metric cannot be identified across included studies, effect sizes will be categorised into small, medium and large effects. Where conclusions of synthesised data are dependent on SWiM, graphical and tabular methods will be used to summarise the data across the key exposure groupings, such as use of tables and forrest plots. Where this is not possible the use of effect direction plots will be considered.

Meta-analysis

With regards to quantitative analysis we will attempt where possible to conduct meta-analyses. Following a scoping search, the predominately used quantitative social media use measures reported in the literature we anticipate are amenable to meta-analysis include time spent on social media, frequency of use of social media and exposure to health risk behaviour content on social media. We will plan to investigate these measures through conducting three meta-analyses, however, anticipate this may be subject to change depending on data availability and heterogeneity observed across studies. Data permitting, the following steps will be conducted.

Meta-analysis A: Time spent on social media

1) Datapoints from included studies investigating time spent on social media will be pooled using a random effects model to estimate: the overall association between time spent on social media and a) adolescent health risk behaviours; b) alcohol use; c) tobacco use; d) drug use; e) use of ENDS; f) unhealthy dietary behaviours; g) inadequate physical activity; h) antisocial behaviour; i) gambling; j) sexual health risk behaviours; k) multiple risk behaviours. We anticipate substantial heterogeneity across studies and therefore anticipate using random rather than fixed-effects models. Where data are not available to allow a meta-analysis, we will note the lack of data.
2) Data permitting, studies will be grouped according to the type of social media used (e.g., general social media use, use of social networking sites), study context/setting (high vs low-and middle-income countries), baseline socioeconomic position of study participants, gender of study participants, age of study participants, and subgroup analysis/meta-regression will be performed.
3) Sensitivity analysis will be performed to explore any differences by study design (cross sectional vs longitudinal), effect estimates reported in included studies (adjusted and unadjusted vs unadjusted estimates) and by risk of bias. An additional sensitivity analysis is planned excluding any data points where the sample of a study overlaps with other populations out with the specified age of interest (10-19 years).

Meta-analysis B: Frequency of use of social media

4) Meta-analysis B will synthesis data points from included studies investigating frequency of use of social media using a random effects model to estimate: the overall association between frequency of use of social media and a) adolescent health risk behaviours; b) alcohol use; c) tobacco use; d) drug use; e) use of ENDS; f) unhealthy dietary behaviours; g) inadequate physical activity; h) antisocial behaviour; i) gambling; j) sexual health risk behaviours; k) multiple risk behaviours.
5) Subgroup analysis/meta-regression and sensitivity analyses will be performed as per meta-analysis A.

Meta-analysis C: Exposure to health risk behaviour content on social media

6) Data points from included studies which explore exposure to health risk behaviour content on social media will be pooled using a random effects model to estimate: the overall association between exposure to health risk behaviour content on social media and a) adolescent health risk behaviours; b) alcohol use; c) tobacco use; d) drug use; e) use of ENDS; f) unhealthy dietary behaviours; g) inadequate physical activity; h) antisocial behaviour; i) gambling; j) sexual health risk behaviours; k) multiple risk behaviours.
7) Data permitting, studies will be grouped according to the type of social media used (e.g., general social media use, use of social networking sites), type of risk behaviour content study population is exposed to on social media (e.g., user-generated content, marketer-generated content), study context/setting (high vs low-and middle-income countries), baseline socioeconomic position of study participants, gender of study participants, age of study participants, and subgroup analysis/meta-regression will be performed.
8) Sensitivity analysis will be performed as per meta-analysis A and B.

Random-effects models will be used to allow for the assumption that different studies are estimating different yet related exposure effects.[49] Heterogeneity will be investigated using the I^2 statistic and reported alongside each model. As well as being reported in text, pooled estimates and I^2 values will be incorporated into forest plots. If 10 or more datapoints are identified for any analysis, a funnel plot will be produced to assess potential for publication bias.

With regard to planned subgroup analyses/meta-regression, if two or fewer studies are found in a given sub-category of a binary or multi-categorical moderator, formal moderation analysis will not be conducted for that specific variable, to protect against drawing unreliable conclusions from the meta analytic results. If additional moderators are identified during the review or amendments are made based on the availability of data, we will note these modifications following completion of the pre-registration process.

CERTAINTY ASSESSMENT

The overall certainty of the body of evidence for each individual outcome will be assessed using the GRADE approach,[57] thereby keeping with standards for reporting outlined by the Cochrane Collaboration.[49] The GRADE approach classifies certainty through careful consideration of five factors: within-study risk of bias (methodological quality), directness of evidence, inconsistency (heterogeneity), risk of publication bias and precision of effect estimates.[57] Consequently, each individual outcome is assigned one of four levels of quality 'high', 'moderate', 'low' or 'very low'. Results of the GRADE certainty assessment for each outcome will be presented alongside key information including the number of participants and studies for each outcome and the exposure effect for the relevant subgroup, in a Summary of Findings (SoF) table. The seven key outcomes intended to be included in the SoF table are:

- Multiple risk behaviours
- Alcohol use
- Drug use
- Tobacco use
- Use of ENDS
- Sexual risk behaviours
- Gambling

Due to data availability, these planned outcomes may be subject to change. In aiding transparency, if there are any critical outcomes which lack available evidence, this will be recorded. As outlined in the GRADE guidelines and the Cochrane Handbook observational studies will start as 'low quality'.[49,57] However, special strengths or limitations can modify the quality of the evidence. For example, if studies demonstrate large effects with no clear bias explaining those effects, the evidence may be upgraded to 'moderate' or even 'high quality' if the effect is large enough.[49]

DISSEMINATION

We will seek to disseminate the central findings of the review to the academic community through publication in a relevant high-impact peer reviewed journal and at topic-specific conferences. Lay friendly press releases and summaries will be produced alongside support from Public Engagement colleagues within the MRC/CSO Social and Public Health Sciences Unit and will be disseminated via social media. All outputs will be disseminated to policymakers via the Advisory group as part of our wider research project 'Social media and adolescent engagement in health risk behaviours'. The manuscript will be prepared in accordance with the PRISMA reporting guidelines.

APPENDICES

Appendix 1: Types of social media, adapted from Sloan and Quan-Haase[22]

Social media type	Definitions	Examples
Social networking sites	Web-based services which facilitate individual construction of a public or semi-public profile within a bounded system, compose a list of other users with which they share a connection, and view and traverse their list of connections as well as those created by others within the system.[82]	Facebook, SnapChat, Instagam, WhatsApp, Twitter, LinkedIn, WeChat
Microblogging sites	Services which are centred on short updates which are forwarded to anyone subscribed to receive the updates.[83]	Twitter, Tumblr
Blogs and forums	Online forums allow forum members to have conversations by posting messages. Blog comments are attached to blogs and usually the discussion is focussed on the topic of the blog post.[83]	LiveJournal, Wordpress
Media sharing sites	Services which facilitate uploading and sharing of media including pictures and video. The majority of services have other social features such as profiles, commenting, etc.[83]	YouTube, Pinterest, Instagram, Snapchat, Facebook
Geo-location-based sites	Services which allow users to connect and exchange messages based on their location.	Foursquare, Tinder
Bookmarking sites	A website which ranks references (bookmarks) to other websites contributed by users who use the site. Users can add comments to the bookmarks and make then private or public. The act of bookmarking indicates to others that an individual is interested in a given resource.[84]	Delicious, StumbleUpon, Twitter
Social news sites	Services that allow individuals to post news items or links to outside articles and then facilitates user voting of the items. The voting is the primary social aspect, as items which get the most votes are displayed the most prominently. The community of users decide which news items are seen my more people.[83]	Reddit, Digg
Collaborative authoring sites	Web-based services which allow users to create content and allow individuals with access to the service to modify, edit or review that content.[70]	Wikipedia, Google Docs
Web conferencing	An umbrella term for types of online collaborative services including web-seminars (webinars), webcasts, and peer-level web meetings.	Skype, Zoom
Scheduling and meeting	Web-based services which facilitate group-based decisions regarding events.	Microsoft Outlook, Doodle, Google Calendar

Appendix 2: EMBASE search strategy

1	adolescent/ or child/ or juvenile/
2	middle school student/ or student/ or high school student/
3	("young people" or youth or "school child*" or teen* or "young person*" or "middle school" or middle-school or "secondary school" or "high school" or iGen or "generation Z" or "gen Z").ab,ti.
4	1 or 2 or 3
5	online social network/ or social media/ or smart phone/ or internet/ or screen time/
6	(("screen time" or "social media" or "social networking" or "social-networking" or "social network* site*" or "web 2.0" or "online game*" or "online gaming" or "online social gaming" or hashtag or "instant messag*" or instagram or "Whats App" or whatsapp or facebook or twitter or linkedin or youtube or "you tube" or tumblr or vine or snapchat or myspace or bebo or reddit or neknominate or myspace or wickr or telegram or whisper or "kik messenger" or "Tencent QQ" or wechat or meetup or tiktok or hinge or happn or bumble or grindr or Tinder or "inner circle" or periscope) adj2 (usage or use*)).ab,ti.
7	("screen time" or "social media" or "social networking" or "social-networking" or "social network* site*" or "web 2.0" or "online game*" or "online gaming" or "online social gaming" or hashtag or "instant messag*" or instagram or "Whats App" or whatsapp or facebook or twitter or linkedin or youtube or "you tube" or tumblr or vine or snapchat or myspace or bebo or reddit or neknominate or myspace or wickr or telegram or whisper or "kik messenger" or "Tencent QQ" or wechat or meetup or tiktok or hinge or happn or bumble or grindr or Tinder or "inner circle" or periscope).ab,ti.
8	5 or 6 or 7
9	high risk behavior/ or "substance use"/ or substance abuse/
10	("substance misuse*" or "substance use behav*" or "risk taking behav*" or "risk-taking behav*" or "risk behav*" or "risk-behav*" or "risky behav*" or "multiple risk behav*").ab,ti.
11	9 or 10
12	chewing tobacco/ or tobacco/ or smokeless tobacco/ or tobacco dependence/ or "tobacco use"/ or tobacco consumption/ or tobacco snuff/ or cigarette/ or cigarette smoking/ or adolescent smoking/ or smoking/
13	("smoking initiation" or "smoking behav*").ab,ti.
14	12 or 13
15	exp electronic cigarette/
16	("electronic nicotine delivery system*" or e-cigarette* or Juul or vaping or vape).ab,ti.
17	15 or 16
18	underage drinking/ or binge drinking/ or alcohol consumption/ or drinking behavior/ or alcohol abstinence/ or alcoholism/ or alcohol abuse/

19 ("alcohol intoxication" or "problem drinking" or "alcohol intake" or "alcohol use*" or temperance or "under-age drinking" or "under age drinking" or "underage drinking").ab,ti.

20 18 or 19

21 "cannabis use"/ or cannabis addiction/ or illicit drug/ or drug abuse/

22 ("street drug*" or "drug use*" or "drug misuse*" or weed or skunk or cannabis or marijuana or cocaine or "special k" or crack or methamphetamine* or ecstasy or heroin or LSD or steroid* or ketamine or MDMA or GHB or GBL).ab,ti.

23 21 or 22

24 antisocial behavior/ or social problem/ or assault/ or physical violence/ or gang/ or fighting/ or theft/ or juvenile delinquency/

25 (steal* or shoplift* or vandal* or "public nuisance" or "physical assault" or "anti-social behav*").ab,ti.

26 24 or 25

27 adolescent pregnancy/ or sexting/ or sexually transmitted disease/ or unwanted pregnancy/ or sexual behavior/ or sexual intercourse/ or acquired immune deficiency syndrome/ or Human immunodeficiency virus/

28 ("unwanted pregnancy" or "sexually transmitted infection*" or STIs or STDs or "teen* pregnancy" or "unprotected sex*" or "first intercourse" or "casual sexual relations*" or "intimate sexual contact" or "under age sex" or "underage sex*" or "under-age sex*" or " underage pregnancy" or " under age pregnancy" or "under-age pregnancy" or sex-text or "sex text" or "sexual behav*" or "sexual risk").ab,ti.

29 27 or 28

30 gambling/

31 (betting or gambling).ab,ti.

32 30 or 31

33 unhealthy diet/ or sugar-sweetened beverage/ or fast food/ or adolescent nutrition/

34 ("poor diet*" or "dietary behav*" or "eating behav*" or "sugary drink*" or sweet*).ab,ti.

35 33 or 34

36 physical inactivity/ or exercise/ or physical activity/ or fitness/ or sedentary lifestyle/

37 ("physical inactiv*" or "physical activ*" or exercis* or sport*).ab,ti.

38 36 or 37

39 11 or 14 or 17 or 20 or 23 or 26 or 29 or 32 or 35 or 38

40 4 and 8 and 39

Appendix 3: Advisory group members

Name	Occupation
Kirsty Blenkins	Public Health England, London, UK
Lee Carlton	Public Health Scotland, Glasgow, UK
Neil Coles	We Are With You, Kent, UK
Nicholas Hickmott	We Are With You, Kent, UK
John Holmes	Professor in Alcohol Policy, University of Sheffield, UK
Rachel Macpherson	Scottish Government, Edinburgh, UK
Dr Ross Whitehead	Public Health Scotland, Edinburgh, UK

Appendix 4: Feedback advisory group (online survey)

	Rank outcomes according to their relative importance for the scope of the reviews and general public health decision making in the context of social media use; 9-point Likert scale (categories: 1 to 3- of limited importance; 4 to 6- important; 7 to 9 – critical	
Outcomes	Average score	Rank
Alcohol use	7.16	2
Tobacco use	6.50	4
Use of ENDS	5.83	5
Drug use	7.00	3
Unhealthy dietary behaviours	5.00	8
Inadequate physical activity	5.00	8
Antisocial behaviour	5.00	8
Gambling	5.16	7
Sexual risk behaviours	5.60	6
Multiple risk behaviours	7.50	1
	How well do the presented outcomes cover the review scope?	
Answers	Rating	Number of responses
Important outcomes are presented	71%	5
Important outcomes are missing	29%	2
Comments(2):	Selling and advertising of illicit substances	
	Mental health-related outcomes Bullying	

REFERENCE LIST

1. Arnett JJ. Emerging adulthood. A theory of development from the late teens through the twenties. *Am J Psychol*. 2000;55(5):469-480.

2. Blakemore SJ, Choudhury S. Development of the adolescent brain: implications for executive function and social cognition. *J Child Psychol Psychiatry*. 2006;47(3-4):296-312.

3. Booth JN, Tomporowski PD, Boyle JME, et al. Obesity impairs academic attainment in adolescence: findings from ALSPAC, a UK cohort. *Int J Obes (Lond)*. 2014;38(10):1335-1342. doi:10.1038/ijo.2014.40

4. Latvala A, Rose RJ, Pulkkinen L, Dick DM, Korhonen T, Kaprio J. Drinking, smoking, and educational achievement: Cross-lagged associations from adolescence to adulthood. *Drug Alcohol Depend*. 2014;137(1):106-113. doi:10.1016/j.drugalcdep.2014.01.016

5. McCullough ML, Patel A V., Kushi LH, et al. Following cancer prevention guidelines reduces risk of cancer, cardiovascular disease, and all-cause mortality. *Cancer Epidemiol Biomarkers Prev*. 2011;20(6):1089-1097. doi:10.1158/1055-9965.EPI-10-1173

6. Mokdad AH, Forounzanfar MH, Daoud F, et al. Global burden of diseases, injuries, and risk factors for young people's mental health during 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. *Lancet*. 2016;387:2283-2401.

7. Gopinath B, Flood VM, Burlutsky G, Mitchell P. Combined influence of health behaviors on total and cause-specific mortality. *Arch Intern Med*. 2010;170(17):1605-1607. doi:10.1001/archinternmed.2010.303

8. Statista. Number of social media users worldwide from 2010-2021 (in billions). https://www.statista.com/statistics/ 278414/number-of-worldwide-social-network-users/. Published 2018. Accessed February 14, 2020.

9. Toseeb U, Inkster B. Online social networking sites and mental health research. *Front Psychiatry*. 2015;6(36). doi:10.3389/fpsyt.2015.00036

10. World Health Organization. Adolescent health. https://www.who.int/southeastasia/health-topics/adolescent-health. Published 2020. Accessed February 18, 2020.

11. Greenwood S, Perrin A, Duggan M. *Social Media Update 2016*. Washington, D.C; 2016. http://assets.pewresearch.org/wp-content/uploads/sites/14/2016/11/10132827/PI_2016.11.11_Social-Media-Update_FINAL.pdf.

12. Anderson M, Jiang J. *Teens, Social Media and Technology 2018*. Washington, D.C; 2018. http://www.pewinternet.org/2018/05/31/teens- social-media-technology-2018/.

13. Barry CT, Sidoti CL, Briggs SM, Reiter SR, Lindsey RA. Adolescent social media use and mental health from adolescent and parent perspectives. *J Adolesc*. 2017;61:1-11. doi:10.1016/j.adolescence.2017.08.005

14. Royal Society for Public Health. *Status of Mind-Social Media and Young People's Mental Health and Wellbeing*. London; 2017.

15. Ofcom. *Children and Parents: Media Use and Attitudes Report 2018*. London, UK; 2019. https://www.ofcom.org.uk/__data/assets/pdf_file/0024/134907/children-and-parents-media-use-and-attitudes-2018.pdf.

16. Coyne SM, Rogers AA, Zurcher JD, Stockdale L, Booth M. Does time spent using social media impact mental health ?: An eight year longitudinal study. *Comput Human Behav*. 2020;104(2019):106160.

doi:10.1016/j.chb.2019.106160

17. Poushter J, Bishop C, Chwe H. *Social Media Use Continues to Rise in Developing Countries but Plateaus across Developed Ones*. USA; 2018. https://assets.pewresearch.org/wp-content/uploads/sites/2/2018/06/15135408/Pew-Research-Center_Global-Tech-Social-Media-Use_2018.06.19.pdf.

18. Newman BM, Lohman BJ, Newman PR. Peer group membership and a sense of belonging: their relationship to adolescent behavior problems. *Adolescence*. 2007;42(166):241-263.

19. Wright JD, Herring SC, Teens KS. Teens, gender, and self -presentation in social media. In: *International Encyclopedia of the Social and Behavioural Sciences*. 2nd edn. ; 2015:146-152.

20. Yates S, Lockley E. Social media and social class. *Am Behav Sci*. 2018;62(9):1291-1316. doi:10.1177/0002764218773821

21. Hoelzel M. UPDATE: A breakdown of the demographics for each of the different social networks. http://www.businessinsider.com/ update-a-breakdown-of-the-demographics-for-each-of-the-different-social-networks-2015-6. Published 2015. Accessed February 27, 2020.

22. Sloan L, Quan-Haase A. *The SAGE Handbook of Social Media Research Methods*. London: SAGE Publications Ltd; 2017.

23. Ellison NB, Boyd D. Sociality through social network sites. In: Dutton WH, ed. *The Oxford Handbook of Internet Studies*. ; 2013:151-172.

24. Rideout V. Generation Rx.com What are young people really doing online? *Mark Heal Serv*. 2002;22(1):26-30.

25. Ilakkuvan V, Johnson A, Villanti AC, Evans WD, Turner M. Patterns of social media use and their relationship to health risks among young adults. *J Adolesc Heal*. 2019;64(2):158-164. doi:10.1016/j.jadohealth.2018.06.025

26. Gardner M, Steinberg L. Peer influence on risk taking, risk preference, and risky decision making in adolescence and adulthood: an experimental study. *Dev Psychol*. 2005;41(4):625-635.

27. Messerlian C, Gillespie M, Derevensky JL. Beyond drugs and alcohol: Including gambling in a high-risk behavioural framework. *Paediatr Child Health (Oxford)*. 2007;12(3):199-204. doi:10.1093/pch/12.3.199

28. Critchlow N, MacKintosh AM, Hooper L, Thomas C, Vohra J. Participation with alcohol marketing and user-created promotion on social media, and the association with higher-risk alcohol consumption and brand identification among adolescents in the UK. *Addict Res Theory*. 2019;27(6):515-526. doi:10.1080/16066359.2019.1567715

29. Moreno MA, Christakis DA, Egan KG, Brockman LN, Becker T. Associations between displayed alcohol references on facebook and problem drinking among college students. *Arch Pediatr Adolesc Med*. 2012;166(2):157-163. doi:10.1001/archpediatrics.2011.180

30. Moreno MA, Parks M, Richardson LP. What are adolescents showing the world about their health risk behaviors on myspace? *MedGenMed Medscape Gen Med*. 2007;9(4):9. http://www.ncbi.nlm.nih.gov/pubmed/18311359. Accessed October 1, 2019.

31. Steinberg L. A social neuroscience perspective on adolescent risk-taking. *Dev Rev*. 2008;28(1):78-106. doi:10.1016/j.dr.2007.08.002

32. Sawyer S, Afifi R, Bearinger L, et al. Adolescence: A foundation for future health. *Lancet*. 2012;379(9826):1630-1640. doi:10.1016/S0140-6736(12)60072-5

33. Moreno MA, Briner LR, Williams A, Walker L, Christakis DA. Alcohol references on social networking websites. *J Adolesc Heal*. 2009;45(4):420-422.

34. Litt DM, Stock ML. Adolescent alcohol-related risk cognitions: The roles of social norms and social networking sites. *Psychol Addict Behav*. 2011;25(4):708-713. doi:http://dx.doi.org/10.1037/a0024226

35. Huang GC, Unger JB, Soto D, et al. Peer influences: The impact of online and offline friendship networks on adolescent smoking and alcohol use HHS public access. *J Adolesc Heal*. 2014;54(5):508-514. doi:10.1016/j.jadohealth.2013.07.001

36. Moreno MA, Whitehill JM. Influence of social media on alcohol use in adolescents and young adults. *Alcohol Res Curr Rev*. 2014;36(1):91-100.

37. Boyle SC, LaBrie JW, Froidevaux NM, Witkovic YD. Different digital paths to the keg? How exposure to peers' alcohol-related social media content influences drinking among male and female first-year college students. *Addict Behav*. 2016;57:21-29. doi:10.1016/j.addbeh.2016.01.011

38. Jernigan D, Noel J, Landon J, Thornton N, Lobstein T. Alcohol marketing and youth alcohol consumption: a systematic review of longitudinal studies published since 2008. *Addiction*. 2017;112:7-20. doi:10.1111/add.13591

39. US Department of Health and Human Services. *The Health Consequences of Smoking- 50 Years of Progress: A Report of the Surgeon General*. Atlanta, GA; 2014.

40. Papasolomou I, Melanthiou Y. Social media: marketing public relations' new best friend. *J Promot Manag*. 2012;18(3):319-328. doi:10.1080/10496491.2012.696458

41. Nesi J, Rothenberg WA, Hussong AM, Jackson KM. Friends' alcohol-related social networking site activity predicts escalations in adolescent drinking: mediation by peer norms. *J Adolesc Heal*. 2017;60(6):641-647. doi:10.1016/j.jadohealth.2017.01.009

42. Curtis BL, Lookatch SL, Ramo DE, McKay JR, Feinn RS, Kranzler HR. Meta-analysis of the association of alcohol-related social media use with alcohol consumption and alcohol-related problems in adolescents and young Adults. *Alcohol Clin Exp Res*. 2018;42(6):978-986. doi:10.1111/acer.13642

43. Frost RL, Rickwood DJ. A systematic review of the mental health outcomes associated with Facebook use. *Comput Human Behav*. 2017;76:576-600. doi:10.1016/j.chb.2017.08.001

44. Moreno MA, Parks MR, Zimmerman FJ, et al. Display of health risk behaviors on mySpace by adolescents prevalence and associations. *Arch Pediatr Adolesc Med*. 2009;163(1):27-34. doi:10.1001/archpediatrics.2008.528

45. Marker C, Gnambs T, Appel M. Active on Facebook and failing at school? Meta-analytic findings on the relationship between online social networking activities and academic achievement. *Educ Psychol Rev*. 2018;30(3):651-677. doi:10.1007/s10648-017-9430-6

46. Orben A. Teenagers , screens and social media : a narrative review of reviews and key studies. *Soc Psychiatry Psychiatr Epidemiol*. 2020;(0123456789). doi:10.1007/s00127-019-01825-4

47. Marino C, Gini G, Vieno A, Spada MM. The associations between problematic Facebook use, psychological distress and well-being among adolescents and young adults: A systematic review and meta-analysis. *J Affect Disord*. 2018;226:274-281. doi:10.1016/j.jad.2017.10.007

48. Livingstone S, Nandi A, Banaji S, Stoilova M. *Young Adolescents and Digital Media: Uses, Risks and Opportunities in Low- and Middle-Income Countries: A Rapid Evidence Review*. London, UK; 2017.

49. Higgins JPT, Thomas J. *Cochrane Handbook for Systematic Reviews of Interventions. Version 6.* The Cochrane

Collaboration; 2019. https://training.cochrane.org/handbook/current.

50. Vannucci A, Simpson EG, Gagnon S, Ohannessian CMC. Social media use and risky behaviors in adolescents: A meta-analysis. *J Adolesc*. 2020;79(January):258-274. doi:10.1016/j.adolescence.2020.01.014

51. Smith LW, Liu B, Degenhardt L, et al. Is sexual content in new media linked to sexual risk behaviour in young people? A systematic review and meta-analysis. *Sex Health*. 2016;13(6):501-515. doi:10.1071/SH16037

52. Kneale D, Thomas J, Harris K. Developing and optimising the use of logic models in systematic reviews: Exploring practice and good practice in the use of programme theory in reviews. *PLoS One*. 2015;10(11):1-26. doi:10.1371/journal.pone.0142187

53. Rehfuess EA, Booth A, Brereton L, et al. Towards a taxonomy of logic models in systematic reviews and health technology assessments: A priori, staged, and iterative approaches. *Res Synth Methods*. 2018;9(1):13-24. doi:10.1002/jrsm.1254

54. Moher D, Liberati A, Tetzlaff J, et al. Preferred reporting items for systematic reviews and meta-analyses: The PRISMA statement. *PLoS Med*. 2009;6(7). doi:10.1371/journal.pmed.1000097

55. Stroup DF, Berlin JA, Morton SC, et al. Meta-analysis of observational studies in epidemiolgy: A proposal for reporting. *JAMA*. 2000;283(15). doi:10.1007/978-94-007-3024-3_10

56. Steele J., Brown J. Adolescent room culture: Studying media in the context of everyday life. *J Youth Adolesc*. 1995;24(551-576).

57. GRADE Working Group. *Handbook for Grading the Quality of Evidence and the Strength of Recommendations Using the GRADE Approach. Updated October 2013.* GRADE Working Group; 2013. www.guidelinedevelopment.org/handbook/.

58. Shamseer L, Moher D, Clarke M, et al. Preferred reporting items for systematic review and meta-analysis protocols (prisma-p) 2015: Elaboration and explanation. *BMJ*. 2015;349(January):1-25. doi:10.1136/bmj.g7647

59. Oxford English Dictionary. Definition of social media. https://en.oxforddictionaries.com/definition/social_media. Accessed February 4, 2020.

60. Sawyer SM, Azzopardi PS. Viewpoint The age of adolescence. *Lancet child Adolesc Heal*. 2018;2(18):223-228. doi:10.1016/S2352-4642(18)30022-1

61. World Health Organisation. *The Global Strategy for Women's, Children's and Adolescents Health (2016-30)*. Geneva, Switzerland; 2015. http://www.who.int/life-course/partners/ global-strategy/ewec-globalstrategyreport-200915.pdf?ua=1.

62. Macarthur G, Dm C, Redmore J, et al. Individual-, family-, and school-level interventions targeting multiple risk behaviours in young people (Review). *Cochrane Database Syst Rev*. 2018;(10):433. doi:10.1002/14651858.CD009927.pub2.www.cochranelibrary.com

63. Centre for Disease Control and Prevention. Youth Risk Behavior Surveillance System (YRBSS). https://www.cdc.gov/healthyyouth/data/yrbs/index.htm. Published 2018. Accessed January 31, 2020.

64. Stoff DM, Breiling J, Maser JD. Handbook of antisocial behaviour. *Psychol Rev*. 1993;100:674-701.

65. Hilton MJ, Ann Rose C, Sweanor DT, Henningfield J. Smoking. Encylopaedia Britanica. https://www.britannica.com/topic/smoking-tobacco. Published 2020. Accessed February 24, 2020.

66. Steiner WG. Drug use. Encylopaedia Britanica. https://www.britannica.com/topic/drug-use. Published 2020.

Accessed February 24, 2020.

67. U.S. Food & Drug Administration. Vaporizers, e-cigarettes, and other electronic nicotine delivery systems (ENDS). https://www.fda.gov/tobacco-products/products-ingredients-components/vaporizers-e-cigarettes-and-other-electronic-nicotine-delivery-systems-ends. Published 2020.

68. Stok FM, Renner B, Allan J, et al. Dietary behavior: An interdisciplinary conceptual analysis and taxonomy. *Front Psychol*. 2018;9(SEP):1-12. doi:10.3389/fpsyg.2018.01689

69. Bull FC, Armstrong TP, Dixon T, Ham S, Neiman A, Pratt M. Physical inactivity. In: *Comparative Quantification of Health Risks. Global and Regional Burden of Disease Attributal to Selected Major Risk Factors*. Geneva: World Health Organization; 2004:729-881.

70. Archambault PM, van de Belt TH, Grajales FJ, et al. Wikis and collaborative writing applications in health care: A scoping review. *J Med Internet Res*. 2013;15(10):e210.

71. Chawla N, Sarkar S. Defining "High-risk sexual behavior" in the context of substance use. *J Psychosexual Heal*. 2019;1(1):26-31. doi:10.1177/2631831818822015

72. Chen X, Faviez C, Schuck S, et al. Mining patients' narratives in social media for pharmacovigilance: Adverse effects and misuse of methylphenidate. *Front Pharmacol*. 2018;9(MAY):541. doi:10.3389/fphar.2018.00541

73. Sidani JE, Shensha A, Hoffman B, Hanmer J, Primack BA. The association between social media use and eating concerns among U.S. young adults. *J Acad Nurt Diet*. 2016;116(9):1465-1472. doi:10.1016/j.physbeh.2017.03.040

74. Dyson MP, Hartling L, Shulhan J, et al. A systematic review of social media use to discuss and view deliberate self-harm acts. *PLoS One*. 2016;11(5):1-15. doi:10.1371/journal.pone.0155813

75. Marchant A, Hawton K, Stewart A, et al. A systematic review of the relationship between internet use, self-harm and suicidal behaviour in young people: The good, the bad and the unknown. *PLoS One*. 2017;12(8):e0181722. doi:10.1371/journal.pone.0181722

76. Rojek S, Klys M, Strona M, Maciow M. "Legal highs" -Toxicity in the clinical and medico-legal aspect as exemplified by suicide with bk-MBDB administration. *Forensic Sci Int*. 2012;222(1-3):e1-e6. doi:http://dx.doi.org/10.1016/j.forsciint.2012.04.034

77. Sedgwick R, Epstein S, Dutta R, Ougrin D. Social media, internet use and suicide attempts in adolescents. *Curr Opin Psychiatry*. 2019;32(6):534-541. doi:10.1097/YCO.0000000000000547

78. Centre for Reviews and Dissemination. *Systematic Reviews: CRD's Guidance for Undertaking Reviews in Health Care*. York, England: Centre for Reviews and Dissemination, University of York; 2008. https://www.york.ac.uk/media/crd/Systematic_Reviews.pdf.

79. Wells G, Shea B, O'Connell D. *The Newcastle-Ottawa Scale (NOS) for Assessing the Quality of Nonrandomised Studies in Meta-Analyses*. Ottawa; 2014.

80. Herzog R, Alvarez-Pasquin MJ, Diaz C. Are healthcare workers' intentions to vaccinate related to their knowledge, beliefs and attitudes? a systematic review. *BMC Public Health*. 2013;13.

81. Campbell M, Mckenzie JE, Sowden A, et al. Synthesis without meta-analysis (SWiM) in systematic reviews : reporting guideline. *BMJ*. 2020;368(16890). doi:10.1136/bmj.l6890

82. Boyd DM, Ellison NB. Social network sites: Definition, history, and scholarship. *J Comput Commun*. 2007;13(1):210-230. doi:10.1111/j.1083-6101.2007.00393.x

83. Grahl T. The 6 types of social media. http://timgralh.com/the-6-types-of-socialmedia/. Published 2013. Accessed February 12, 2020.

84. Millen DR, Yang M, Whittaker S, Feinberg J. Social bookmarking and exploratory researche. In: *ECSW'07: Proceedings of the 10th European Conference on Computer-Supported Cooperative Work*. London: Springer; 2007.