BMJ Open

From screen time to the digital level of analysis: a scoping review of measures for digital media use in children and adolescents

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To cite: Browne DT, May SS, Colucci L, *et al*. From screen time to the digital level of analysis: a scoping review of measures for digital media use in children and adolescents. *BMJ Open* 2021;**11**:e046367. doi:10.1136/bmjopen-2020-046367

► Prepublication history and additional online supplemental material for this paper are available online. To view these files, please visit the journal online (http://dx.doi.org/10.1136/bmjopen-2020-046367).

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Received 27 October 2020
Revised 06 April 2021
Accepted 29 April 2021

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ABSTRACT

Objectives This scoping review aims to facilitate psychometric developments in the field of digital media usage and well-being in young people by (1) identifying core concepts in the area of "screen time" and digital media use in children, adolescents, and young adults, (2) synthesising existing research paradigms and measurement tools that quantify these dimensions, and (3) highlighting important areas of need to guide future measure development.

Design A scoping review of 140 sources (126 database, 14 grey literature) published between 2014 and 2019 yielded 162 measurement tools across a range of domains, users, and cultures. Database sources from Ovid MEDLINE, PsycINFO and Scopus were extracted, in addition to grey literature obtained from knowledge experts and organisations relevant to digital media use in children. To be included, the source had to: (1) be an empirical investigation or present original research, (2) investigate a sample/target population that included children or young persons between the ages of 0 and 25 years of age, and (3) include at least one assessment method for measuring digital media use. Reviews, editorials, letters, comments and animal model studies were all excluded.

Measures Basic information, level of risk of bias, study setting, paradigm, data type, digital media type, device, usage characteristics, applications or websites, sample characteristics, recruitment methods, measurement tool information, reliability and validity.

Results Significant variability in nomenclature surrounding problematic use and criteria for identifying clinical impairment was discovered. Moreover, there was a paucity of measures in key domains, including tools for young children, whole families, disadvantaged groups, and for certain patterns and types of usage.

Conclusion This knowledge synthesis exercise highlights the need for the widespread development and implementation of comprehensive, multi-method, multilevel, and multi-informant measurement suites.

Strengths and limitations of this study:

- This scoping review has important and timely objectives, being among the first to synthesise the measurement tools that assess child digital media use on a large scale.
- Many low-risk, reliable and valid measurement tools from a variety of databases, institutional reports and guidelines are included.
- Data extraction focused on the source's methodology (ie, the measurement tools), rather than the data of each source, presenting a novel approach to knowledge synthesis.
- No measurement tools that are non-English or older than 5 years were included in this scoping review, limiting the sources that were assessed.
- A variety of gaps in measurement were identified, including assessment for young children, whole families, disadvantaged groups, and non-self report scales.

INTRODUCTION

There has been a proliferation in studies examining the association between digital media usage in young people and various aspects of well-being, including neurocognitive development in youngsters,[1 2] and anxiety and depression in children, teenagers and young adults.[3 4] Some research supports negative consequences across a range of outcomes, which also include quality of play, parent–child interactions, academic outcomes, executive functioning, language acquisition and sleep, in addition to compromised privacy and exposure to unsafe content.[5–7] Other research points towards notable benefits. For example, a

systematic review conducted by Kostyrka-Allchorne *et al*,[7] concluded that exposure to digital educational content during early childhood improved academic skills and predicted positive academic performance in later childhood. A meta-analysis by Madigan *et al*[8] found that while longer duration of screen use was negatively associated with child language, high-quality screen viewing (i.e., educational content, coviewing with caregivers) was positively associated with child language skills. Additional benefits of digital media exposure include increased social contact and support, access to health information, and relationship benefits related to shared digital play.[6 9] These studies, often widely covered in the news, receive great scrutiny from the scientific community, where a spirited debate currently resounds.[10 11]

One frequent and important criticism surrounds measurement paradigms that fail to capture the complexity of digital media usage, for better or for worse. Indeed, the state-of-the-science requires a move beyond "screen time", and towards a conceptualisation of digital media as it permeates the various contexts in which children and young people develop. In keeping with systemic formulations of the developmental ecology,[12] and expounding on the ideas of "levels of analysis" in developmental psychopathology (e.g., genetic, neurophysiological, individual, family, school, neighbourhood)[13] and frameworks for children's digital safety,[14] our scoping review calls for measures that capture the "digital level of analysis" as a unique and distinct layer of organisation in which digital developmental phenomena can be conceptualised, measured, modelled, and studied in order to best understand the influences and consequences of child well-being in the digital age.[10 15]

The need to develop and disseminate reliable, valid, and comprehensive protocols to measure digital media usage in children, adolescents and families has been clearly articulated.[16–18] The development of such tools is rife with challenge, including debate pertaining to the definition of constructs, inconsistencies in targets for measurement (e.g., hours of screen time vs specific types of screen time) and a relatively new phenomenon compared with other domains of developmental science (e.g., relationships, parenting, psychopathology). The questions of "what is 'screen time' and 'digital media use', and how do we measure them*?*" remain as obvious, yet unanswered, areas for consideration.[10] Indeed, studies considering the putative developmental consequences surrounding the amount of screen usage (i.e., screen time as a crude exposure variable) have yielded provocative findings, though interpretation of these studies have also yielded gross limitations in measurement. Content of media, context of usage and co-occurring developmental phenomena and exposures are important yet unaddressed areas in many studies' measurement protocols.

This scoping review will review and synthesise existent literature on measurement of digital media usage in children, adolescents and young adults, while clarifying conceptual, definitional and methodological challenges present in research and assessment, particularly in the areas of developmental science, psychology/psychiatry and paediatrics. The current project was initiated in hopes of further detailing the nuances of digital media use, in order to address concerns surrounding the imprecision of currently documented associations between "amount" or "duration" of time spent using screen devices (i.e., "screen time") and developmental outcomes.[19 20] The review was developed, designed, and conducted through a collective effort of over 30 developmental scientists, psychiatrists, paediatricians, psychologists, social workers, caregivers, and other stakeholders, all highly interested in advancing research and practice with children and youth in a digitally mediated world that is constantly evolving. For more information on how this project was initially formulated, please refer to the published protocol.[15]

OBJECTIVES

This scoping review aims to (1) identify core concepts in digital media use in children, adolescents, and young adults, (2) map existing research paradigms and measurement tools that operationalise and quantify these key dimensions, and (3) provide integrated findings and suggestions that will be informative to future measurement efforts. Results are intended to inform the development of a "large scale psychometric initiative that seeks to develop a reliable, valid, utilitarian and widely employed suite of instruments that can be deployed by clinicians and scientists to screen, monitor and measure media habits in children and adolescents".[15] Like the review itself, this effort is similarly being championed by the Media Impact Screening Toolkit (MIST) workgroup and backed by Children and Screens: Institute of Digital Media and Child Development. To advance the field, it is critical that constructs are consistently defined, and reliable measurement tools are developed.[21]

METHODS

Protocol and registration

The protocol for this scoping review is published in BMJ Open and accessible at the following address: http://dx.doi.org/10.1136/bmjopen-2019-032184.

Eligibility criteria

To be eligible for inclusion, the source was required to: (1) be an empirical investigation or present original research, (2) investigate a sample/target population that included children or young persons between the ages of 0 and 25 years of age, and (3) include at least one assessment method for measuring digital media use. Reviews, editorials, letters, comments and animal model studies were all excluded. The use of this criteria was to ensure the investigation was of empirically validated measurement tools that specifically targeted digital media usage in children, adolescents and young adults. To avoid

duplication of research findings, we excluded reviews and only included sources conducting original research.

The search for sources that met these criteria was limited to English language sources published in the 5 years preceding the start of the project (i.e., 1 March 2014 to 2 March 2019; Note, there was a delay in completion of this project associated with the COVID-19 pandemic). This criterion was selected based on feasibility (i.e., number of studies), in addition to capturing the historical recency of modern digital media in scientific research. The research team conducting this review spoke English and limiting the years reduced the amount of sources meeting inclusion/exclusion criteria to a viable number for a single scoping review. Originally, this project aimed to include sources published since 2007 (the year the iPhone was released). However, this yielded far too many results, including some that were outdated (e.g., measurements of MySpace usage). Since this review aims to conceptualise the measurement of child, adolescent, and young adult digital media use in the present technological landscape, this time restriction should not present any bias or systematically alter the findings, while maintaining modernity.

Patient and public involvement

This review did not include the involvement of human research participants (nor patients or the public). However, it was motivated by the observed clinical need for a greater understanding of the current landscape of measurement tools that may be applied in practice settings when working with patients and members of the public. It is anticipated that the results of this review will inform utilitarian, feasible, and widely used frameworks and tools, supporting better and more accurate identification of problematic digital media use in children, adolescents, and young adults. Moreover, the results of this work will be publicly distributed via the provision of healthcare that incorporates the findings from this research.

Information sources

The search for relevant sources was conducted using the following databases: Ovid MEDLINE, PsycINFO and Scopus. The most recent search was executed on 9 July 2019 for sources published between 1 March 2014 to 1 March 2019. Grey literature was obtained from knowledge experts and organisations relevant to digital media use among children, adolescents, and young adults in the form of reports or original measurement tools. This search strategy for grey literature followed guidelines from the Cochrane Handbook, Centre for Reviews and Dissemination and the Canadian Agency for Drugs and Technology in Health "Grey Matters".

Search

A detailed search strategy was designed by an expert librarian and information specialist at the University of Waterloo who is a co-author on this manuscript (JS). The comprehensive search strategy consisted of author keywords and subject headings that were combined with Boolean terms "AND" and "OR" and "NOT". Please refer to online supplemental appendix A for the search strategy used for MEDLINE. Similar search strategies were conducted in PsycINFO and Scopus.

Selection of sources of evidence

Database sources

Once database sources were retrieved and duplicate sources were removed, the remaining sources were uploaded into Covidence, an online systematic review management software. In Covidence, titles and abstracts of database sources were reviewed independently by two trained reviewers and were marked for inclusion, exclusion or requiring further review based on the eligibility criteria. This was phase 1 of the screening processes. Discrepancies were resolved by an expert reviewer based on an independent review of the source (inter-rater reliability, IRR=0.81).

Database sources deemed to meet eligibility criteria or requiring further review proceeded to the second screening phase: full-text review. During this stage, sources were reviewed independently and in duplication to the first screening to ensure inclusion based on the eligibility criteria. Once again, an expert third reviewer solved conflicts in eligibility evaluation during the second phase of screening based on an independent review. Data extraction was performed on all sources evaluated as meeting all the criteria for inclusion.

Grey literature sources

Grey literature sources were collected and stored manually in an online shared-access folder system. Once duplicates were removed, basic information (e.g., source title, authors, retrieval information) was recorded in a Microsoft Excel spreadsheet for tracking purposes. Using separate copies of the spreadsheet, two trained reviewers accessed each grey literature source and independently evaluated the source's eligibility for inclusion. Evaluations were recorded on each reviewer's spreadsheet, which were then compared for disagreements. Conflicts were resolved independently by a third trained reviewer using a third copy of the spreadsheet with the discrepancies flagged prior. Data extraction was then performed on all sources evaluated as meeting all the criteria for inclusion.

Data charting process

Data extraction for each source was performed using forms completed online via Qualtrics. Two trained, independent reviewers manually extracted data from each source and input the data into the Qualtrics form. Once data extraction was completed for a source, each reviewer would indicate this in Covidence (database sources) or a shared Microsoft Excel tracking sheet (grey literature sources). Following recommendations for the conduction of scoping reviews, this data charting process was pilot tested on 20 articles to ensure consistency between reviewers and determine overall functionality.[22–25] With

the pilot test yielding satisfactory reliability (IRR=0.68), minor modifications were completed in the coding manual to improve construct and response option definitions, at which point IRR increased to 0.81. Once data charting was completed, the data were exported from Qualtrics into Microsoft Excel. The two extractions for each source were then compared and discrepancies were flagged. A third trained reviewer then reviewed these discrepancies, in consultation with the original source, and inputted the final value into a consolidated case for each source. These consolidated cases were then exported to SPSS for data analysis.

Data items

Following recommendations from the Joanna Briggs Institute,[24] basic study information was collected for each source including title, author(s), institution(s), email(s), year of publication and country of origin. Publication type (e.g., article, report, other) was also collected. As mentioned above, level of risk of bias was measured in the form of counts for number of low, high, and unclear judgements listed in Covidence.

For study methodology, the following codes were extracted: setting (lab, clinic, in-home, school, online, etc.), paradigm (naturalistic observation, lab observation, survey, ecological momentary assessment, etc.), and data type (qualitative, quantitative, mixed-methods). Information on the dimensions of digital media use for each source was also collected: digital media type (video games, internet browsing, social media, communication, video streaming, etc.), and devices (laptop/computer, cellphone/smartphone, tablet, television, etc.) were recorded, along with any verbatim definitions of media interaction stated by the researchers.

Since this scoping review was interested in exploring the nuances of digital media use, style of engagement with digital media usage was measured. This included whether the usage was active or sedentary, online or offline, solitary or shared, educational or non-educational, and productive (media usage tasks that yield new resources or improve skills) or consumptive (media usage tasks that do not yield new resources or improve skills). For sources where these characteristics were not explicitly stated, these variables were marked as "unknown/unclear." Additionally, the specific applications or websites (e.g., Facebook, YouTube, Instagram) referenced in each source were also recorded.

Details on the sample characteristics for each source were measured. This included sample population's age group(s) and mean age, sample size, any targeted populations, race (%), ethnicity (%), income level (e.g., socioeconomic status) and the index type used for this calculation. Recruitment methods used to obtain the sample population were recorded, including public advertisement, internal advertisement, direct recruitment of known or unknown participants, and other methods.

After collecting these variables in relation to the sources/studies, the measurement tools, themselves, were assessed. Measurement tool name was recorded, in addition to the measurement type (e.g., survey items, structured interview, video or audio observation, automated statistics, experience sampling), any targeting of the tool to a specific population, and informant type (e.g., self-report, mother or father report, joint parent report, unspecified parent report, teacher report, clinician report). Verbatim information on measurement tools' reliability, validity, strengths and areas for growth were also collected.

Lastly, each measurement tool was assessed by reviewers in terms of reliability and validity with judgements of poor, fair, or good, depending on the researcher(s) discussion of psychometric properties and the evidence provided. Reliability was evaluated based on the following metric: good (clear evidence of all forms of reliability, where applicable, and/or numerical data is presented and >0.70), fair (some discussion and evidence of reliability in one domain but not all and/or reliability statistics are presented but are <0.70) and poor (little to no discussion of the psychometric properties pertaining to reliability). Similarly, validity was evaluated with the following metric: good (clear evidence of all forms of validity, where applicable and/or numerical data is presented and >0.70), fair (some discussion and evidence of validity in one domain but not all and/or validity statistics are presented but are <0.70) and poor (little to no discussion of the psychometric properties pertaining to validity).

Critical appraisal of individual sources of evidence

Methodological quality and study bias were assessed prior to data extraction in Covidence. Based on the series of judgements proposed by Cochrane, four areas of risk were assessed for in each database source: (1) random sequence generation and allocation concealment (e.g., Does the study avoid selection bias by randomly assigning participants into conditions? Is this assignment concealed to researchers and participants?); (2) blinding of participants and personnel (e.g., Was group membership known to the participant? To the research personnel? Is being blind to condition/group essential to the integrity of the study?); (3) incomplete outcome data (e.g., Is the outcome data for all participants available for review? Is missing data and attrition reported by the researchers? How much data is missing? Why is it missing? How was the data analysed in response to the missing data?) and (4) selective reporting (e.g., Do the researchers only report on statistically significant results? Do the researchers only focus on results that support their hypotheses? Do the results differ from the protocol/methodology?).[26]

Each area of risk was judged as being low risk, high risk, or unclear risk, based on specific definitions for each area as proposed by Cochrane.[26] Two reviewers rated level of risk for each source based on these definitions. If a conflict occurred, it was solved with a blind third review. This process of risk assessment was included in the initial pilot testing of 20 sources and, following modifications, satisfactory IRR was achieved (IRR=0.81). The number

of judgements in each risk level were then recorded for each source at the beginning of data extraction. Any sources that were judged as low risk in all four domains were classified as low risk, those that had any number of unknown domains were classified as moderate risk and those with any domains that were categorised as high risk were considered high risk, overall. Sources evaluated as being at a high risk for bias were considered with caution in the data synthesis stage and are flagged in the results (see online supplemental appendix B, table 1; appendix C, table 1.

Synthesis of results

Once data charting had been completed and discrepancies were resolved, all consolidated cases were exported to SPSS V.26 for data analysis. Due to the nature of our investigation, our data analyses were purely descriptive. All categorical variables were analysed for the frequency of each response; many variables were dichotomous, and others had non-mutually exclusive response options. Several items that had alternative response options were re-coded based on inter-rater agreement when the classification by previous reviewers was inappropriate.

For variables with qualitative response options (e.g., Verbatim Definitions of media usage), the responses were thematically analysed and then categorised based on relevant domains. Qualitative and quantitative descriptions are included for these variables within the results section. Sources were assigned a unique "Source #" for identification across multiple tables of information that were created from the data extraction.

RESULTS: DATABASE SOURCES

Selection of sources of evidence

The selection of sources is detailed using a flow diagram based on the Preferred Reporting Items for Systematic reviews and Meta-Analyses for Scoping Reviews guidelines in online supplemental appendix D. The search strategy originally yielded 6459 database sources. After being reviewed for duplicates, 4274 were uploaded to Covidence and a further 57 duplicate sources were removed. The remaining 4217 sources were then screened in Covidence. Stage 1, title and abstract screening, resulted in 4069 database sources being deemed irrelevant and excluded from the study.

During the second screening phase, full-text review, 22 sources were excluded for the following reasons: the source failed to develop a measurement tool of digital media use (9), the full-text was not available in English (8), the tool(s) measured irrelevant factors associated with digital media use (e.g., exposure to violence; 2), the age of participants was not stated (1), the research was preliminary and did not include full data analyses (1), or the source was a duplication (1). Following this phase, 126 database sources were evaluated as meeting eligibility criteria and were moved on to phase three for data extraction. From these database sources, 145 measurement tools were identified. Reference information for all final included sources is listed in online supplemental appendix E.

Characteristics of sources of evidence

Information on all database sources' study characteristics is listed in online supplemental appendix B, table 1. Sources are identified with a unique "Source #" to allow for matching of information across tables 1 and 2 (measurement tool characteristics; online supplemental appendix B). Information in these tables is chunked based on the measurement tool's name.

Study characteristics

Overall, 145 measurement tools were identified across 126 database sources. All the selected publications are classified as empirical articles. Most studies were conducted in Europe (60%) and Asia (26.21%); the remaining 13.9% were conducted in North America (6.90%), South America (2.76%), Australia (1.38%), Africa (<1%), and intercontinental (1%). Further, 10.34% of studies were conducted in multiple countries. The countries/regions with the highest number of sourced publications were Spain, China, Germany and Turkey and the UK. The sample included studies that were conducted in numerous settings including schools (56.55%), online (36.55%), in clinics (3.45%), in homes (9.66%), communities (<1%) and other environments (e.g,. after school programmes, focus groups, gaming halls and hospital based research centres; 2.76%); a small percentage of studies did not specify the research environment adequately enough to code this domain (6.21%).

Quantitative data analysis was the predominant measurement type (91%), with the remaining studies (9%) utilising mixed methods. No studies implemented purely qualitative analysis. Paradigms for each study are listed in online supplemental appendix B, table 1.

Population demographics

The range of participants' mean age in the included database sources was 1.61–43 years. Note, the upper-bound of the age demographic is beyond the upper-bound intended in the scoping review, as some studies included both young people and adults. The age demographics of the database sources sample were as follows: Infancy (Birth –23 months; 1.38%), preschool age (2–5 years old; 1.38%), school age (6–12 years; 35.86%), adolescence (13–17 years; 77.24%) and young adulthood (18–25 years; 74.48%). Sample size varied considerably across samples (mean=1526, range=7–21 205). Each sample size grouping was as follows: Under 100 (4.83%), 101–499 participants (25.52%), 500–999 participants (27.59%), 1000–2499 participants (28.97%), 2500–4999 (10.34%), over 5000 participants (2.76%).

Interestingly, most reported studies (75.17%) did not include any information about the racial profiles of their participants. Of the studies that reported this information, East Asian participants (10.34% of studies) were

the only racial group reported in over 10% of studies. Race and ethnicity profiles (where reported) for each individual study are included in online supplemental appendix B, table 1. A handful of special populations were also studied across the selected articles including: people who play video games regularly, Chinese youth, gamers (including internet gamers), treatment-seeking children with Internet addiction and/or smart phone overuse, people who play Massively Multiplayer Online Role Playing Games (MMORPGs), parents with ambulatory toddlers, Facebook users, individuals with problematic online gaming and Japanese speaking individuals. The SES profile of the selected studies was as follows: Diverse SES (13.10%), high/middle SES (6.21%), low SES (<1%), not specified (80%). In studies where SES was assessed, 75% utilised an author-derived scale and 25% used a common index (ie, an index that has been empirically tested and validated for use in that country/region).

A variety of recruitment methods were used across studies including: public advertisements (8.28%), internal advertisements (17.93%), direct recruitment of unknown individuals (58.62%) and direct recruitment of known individuals (6.9%); the remaining studies used an alternative or unknown recruitment method such as convenience and/or snowball sampling, purposeful sampling, internet-based, simple random sampling, national school surveys from existing databases, online sampling from 25 European countries, and sampling by social studies companies/market research panel (20.69%).

Critical appraisal within sources of evidence

Overall, 74.48% of the selected studies were considered to have a low risk of bias, with 11% moderate risk (where level bias was unclear), and 14.48% high risk. Each source's level of risk is listed in online supplemental appendix B, table 1, flagging the sources considered high risk.

Results of individual sources of evidence

Information on the measurement tools is listed in online supplemental appendix B, table 2.

Digital media characteristics

Digital media type

A myriad of digital media types were reported in the sampled studies: internet (37.93%), video games (34.48%), television (TV)/video (11.72%), social media (14.48%), communication (11.72%), other (7.7%), e-books (2.07%), virtual reality (<1%); 15.17% of studies had unknown or unspecified digital media types that were assessed in the study. About one-fifth (21.38%) of studies directly assessed more than one digital media type. Of those classified as other (5.52%), the following were included: MMORPGs, Digital Video Discs (DVDs), internet and/or computer games, looking at digital photographs, playing with apps based on sound-image associations and playing with puzzles.

Device type

Approximately one-third of studies included multiscreen composites with varying devices (34.48%) and/or phones (27.59%); a smaller percentage of studies also assessed the use of laptops or computers (11.72%), gaming consoles (7.59%), TV (6.2%) and tablets (2.76%). Notably, many studies (40.69%) were unclear in this regard or did not fully specify the devices included in their assessments of screen time use.

Active or sedentary

Regarding media characteristics: 1.38% of studies included both active and sedentary use, 15.86% were classified as sedentary use (non-physical interaction with the digital media) and 82.76% of studies did not clearly specify whether the media use was active vs sedentary. No studies were classified as solely assessing active internet use.

Online or offline

Regarding online use, 48.97% of studies assessed online or media use involving the internet, <1% of the studies assessed solely offline media use and 23.45% of studies assessed both online and offline media use. Approximately one-quarter (26.90%) of the included studies did not specify.

Solitary or shared

It was also of interest to explore whether individuals used screens alone or in connection with others: 4.83% described solitary and shared screen use either in person or online, 1.38% described solitary and shared use that was online only, <1% described shared use in person only (i.e., coviewing), 3.45% described shared use online only, 2.07% described solitary use only, and, importantly, 87.59% of studies did not specify if media usage was solitary or shared either online or in person.

Educational content

Most studies (63.45%) did not report if media use involved educational content (i.e., it is unknown whether these tools measured educational content or not). Of those that did report on this construct (53 studies), 15.1% of studies did assess educational content and 84.91% explicitly stated their measure did not assess educational content.

Productive or consumptive

With reference to type of media use, 36.55% of studies included consumptive media use, 6.21% studied both productive and consumptive media use, no studies assessed solely productive use, and 57.24% of studies were unclear in this regard.

Specific websites and applications

A small number of studies investigated and/or specified which applications were being included in measurements. The following platforms were considered: Facebook (8.97%), Facebook Messenger (2.07%), WhatsApp (4.14%), Twitter (2.76%), Instagram (1.38%), Skype

(<1%), Snapchat (<1%), Youtube (1.38%), all of the previously mentioned (6.21%), other or unknown (28.97%), including online forums, Reddit, Internet gaming, Facebook games, OoV oo, Viber, Omegle, Chatroulette, Skout, 6rounds, Tuenti, videogaming, WeChat, QQ, Sina Weibo or other forms of social media.

Characteristics of measurement tools

Targeted population

A handful of tools were targeted towards a specific population (16.55%—listed in online supplemental appendix B, table 2), though most tools were considered universal measurement tools (82.76%), and <1% of studies were unclear in this regard.

Measure format

Nearly all the selected tools (97.24%) were validated in the context of basic survey methodology, though some studies also made use of automated statistics, ecological momentary assessment, structured interviews with focus groups, among others. The main data collection methodology across studies was self-report (92.41%), followed by passive data collection (3.45%), and unspecified parent report (3.45%). The remaining respondent types included clinician report (1.38%), mother report (1.38%), father report (1.38%), observation (<1%), joint parent report (<1%) and other (1.38%).

Psychometric properties

Reliability of sources was mostly satisfactory with the majority of sources being assessed as having good reliability (66.21%), some having fair reliability (15.17%) and a small number having poor reliability (4.83%). Validity was also evaluated as being mostly satisfactory, with the majority of sources having good validity (61.38%), some with fair validity (17.93%), and a few with poor validity (4.14%). A handful of studies were unclear regarding reliability and validity (13.79% and 16.55%, respectively).

Constructs

By title, 80% of tools claimed to be assessing abnormal screen usage (such as excessive time spent using a device), with definitions ranging from risk factors to clinical diagnoses for conditions such as internet addiction and compulsive internet use. Further, 13.10% of tools assessed general everyday use of screens and content exposure (i.e., non-pathological use). The smallest pool of tools (6.90%) assessed screen time as a component of overall healthy living and general health behaviours.

Cross-cultural validation of tools

About one-in-five tools (22.07%) were studied as cross-cultural validations of the following adaptations: Portuguese, Italian, German, Brazilian, Turkish, Polish, Greek, Vietnamese, Persian, Arabic, Spanish, Korean, Japanese and British.

Measurement tool strengths and areas for growth

Notable areas of strength and areas for growth (where applicable) are thoroughly detailed in online supplemental appendix B, table 2. The following section will describe various patterns that emerged across papers. Numerous strengths were identified across certain studies including novelty in data collection methodology (ecological momentary assessment), assessment modality (phone use) and populations of interest (special populations, both clinical and non-clinical). Further, numerous studies provided a high level of specificity regarding the factor structure of various constructs in this domain (compulsive internet use), while several tools emphasised their alignment with Diagnostic and Statistical Manual-5 (DSM-5) diagnostic criteria for Internet Gaming and related disorders. Importantly, several studies also demonstrated an effort to establish multiple types of reliability and validity within their sample(s). Lastly, numerous studies also highlighted the brevity of their tools, along with ease of administration and interpretation (related to feasibility).

There were also notable areas of growth for the development of future measures, or the refinement of existing tools. Assessments for young children (especially under 5 years of age, but also 6–13 years of age), the inclusion of educational or other content designed to promote development, tools considering shared usage in-person (i.e., coviewing) or online, assessments for entire families, utilisation of data collection methods other than self-report (e.g., observational and passive-data collection), validation of clinically oriented tools in clinical samples, expansion of the construct universe (i.e., content and construct validity) beyond duration of screen media exposure, and minimal tools targeted towards under-represented groups (with the exception of the cross-cultural validations) were the largest areas of need.

Regarding content and construct validity, there was concern surrounding the inclusion of recent technological developments (e.g., social media networks, online gaming and virtual or augmented reality). Furthermore, several domains were inconsistently highlighted as strengths of certain studies/tools and areas of improvement for others, such as: the ability to differentiate between clinical and non-clinical levels of impairment and/or compulsive screen-time use, specificity in symptom identification, assessment of motives for screen use and modalities of screen use, psychometric qualities, the ability to compare between adolescent and parent report and successful cross-cultural validations.

Synthesis of results

Narrative conceptualisation of digital media use

The verbatim definitions of media usage were compiled from all studies. Several themes emerged: 34.40% of studies defined use in terms of frequency, quantity, and duration of use. This typically included defining problematic use as excessive, recurrent, or beyond what an individual intended. Several studies also quantified the number of messages an individual sent, data usage on cell

phones and number of hours of video game play. One study also asked participants to report on non-educational or non-professional screen-time only to specifically assess recreational usage.

Approximately half of the included studies (52.00%) described use with terms that identified clinically significant criteria, including terminology surrounding "addiction" and "dependence", in addition to the reliance on diagnostic criteria. Studies that included descriptions highlighting overuse or problematic use, without clinical terminology were not included in this calculation. There was variability in studies surrounding the definition of disorder and acknowledgement of the presence of addictive processes. Some authors characterised problematic digital media usage as a behavioural addiction and others as an impulse control disorder. Further, numerous papers highlighted the similarities between substance abuse disorder and non-substance (i.e., behavioural) addictions, as a clinical profile for problematic technology use in the absence of formalised diagnostic criteria. By emphasising the presence of addiction, numerous papers also highlighted overall distress and/or impairment that was clinically significant. Notably, the following statement by Komnenić *et al*[27] undergirds a prevalent challenge in this research:

> Internet addiction is not a homogeneous construct; rather it includes different dysfunctional activities performed online that may or may not manifest themselves simultaneously (e.g., video game playing, cybersex, social networking, online gambling) (p.131–132).

Interestingly, in their definitions of digital media use, 8.80% of studies identified hypotheses regarding the addictive nature of screens and provided a rationale for potential overuse. These included behavioural theories regarding escapism and the maladaptive tendency to seek out screens to alleviate negative emotions and neurobiological comparisons between addictive behaviours surrounding technology and substance use disorders. Additionally, under this umbrella, Pontes *et al*[28] mentioned several overarching theoretical paradigms, including the cognitive behavioural and social cognitive models.

Regarding clinical nomenclature, there was substantial variation across studies, which was a limitation consistently acknowledged by researchers. Both generalised and specific labels were used to describe digital media usage with regard to specific platforms and modality of use, including internet gaming disorder (IGD), social networking addiction, internet addiction, mobile phone addiction and Facebook addiction, among others. Several studies also made distinctions between internet addiction as the most severe manifestation of clinically relevant difficulties, and problematic internet *use* as less severe in terms of the degree of dependency, the nature, presence and number of symptoms and the total time and types of use (relative to normative patterns). A handful of studies also distinctly made the argument that difficulties with digital media use and addiction are reflective of an underlying impulse control disorder, while others categorised difficulties in this domain as a unique cyber or technological addiction. The most common terminology that was used across studies was mention of compulsive/problematic use, IGD and internet addiction.

Digital media use symptomatology

A small number of studies (1.60%) explicitly asked participants to self-report their subjective opinions of whether they overused screens to assess for clinically significant problems without objective symptom descriptions, per se.

The most prevalent theme involved a description of symptoms and consequences associated with digital media usage (mentioned in 57.60% of studies). Notably, this was slightly more prevalent than descriptions of clinical diagnoses or formal identifications of pathology as mentioned above, though most studies that provided symptom profiles also had accompanying labels of clinical impairment.

A myriad of symptoms were mentioned across papers, including: loss of control, preoccupation with screen time/device use, withdrawal, tolerance, unsuccessful attempts and/or the inability to stop, loss of interest in typical activities, overall impairment to one's health, relationships, occupational functioning and/or limitations to psychosocial functioning, habitual checking, experiencing an urgency to use and/or check the device, dependency, increased use despite the desire to stop, experiencing irritability and restlessness when unable to use devices for social purposes, depression, anxiety, school withdrawal and reduced quality of life, among others. Numerous studies used the nine DSM-5 criteria specified for IGD; however, studies varied with respect to the use of a formalised set of symptoms.

Purposes of digital media usage

With respect to the purposes of digital media use, several prominent domains were identified across studies (though not all studies specifically detailed the domains of use). Specifically, 22.40% of papers highlighted the use of screens for social interaction and relationship building in their definitions. This included defining digital media use for the purposes of instant communication, maintaining and creating new friendships and collaborative video-game play. Further, 28.80% of papers highlighted the use of screens for the purposes of gaming, including both computer and video games, gaming with others and (presumably) gaming individually across online and offline platforms. Lastly, 4.00% of studies emphasised the use of screens for online sexual activities including the use of pornography and online chatrooms, among others. Notably, our search criteria did not specifically target usage for pornography and sexual activities.

A small percentage of studies (5.60%) reported the possible benefits that can be gleaned from screen time use, including educational, relational and professional

advantages. However, these were usually mentioned with the caveat that, despite the advantages that screens allow, overuse can lead to problems and unwanted side effects.

Issues with conceptualisation and our understanding of digital media usage

Many studies acknowledged that digital media use is inherently complex, multifaceted, and multidimensional, and that their purported instruments were only designed to capture a dimension of an otherwise vast and expansive psychological and behavioural construct. Challenges associated with the ubiquity of devices and the plethora of media activities available were articulated, including the tremendous challenge of neatly isolating these components for analytical purposes. Measure developers have acknowledged that tools have not well captured the simultaneous or multipurpose use of screens or devices. For example, gaming can also include socialising (in the case of online games where young people interact with friends), while also including educational content. Similarly, measures were limited in their capacity to capture simultaneous usage for purposes that are either complementary or in opposition. For example, a young person may be using a word-processing software for homework, while streaming YouTube videos that are related to the project, and intermittently using multiple platforms on a smartphone (eg, TikTok, Snapchat, Facebook Messenger) to connect with peers who are involved in the group project, and others who are not. Furthermore, this youth may have problematic internet usage, commensurate with patterns of withdrawal or other criteria outlined by diagnostic criteria, while another youth who is presently engaged with the same devices may not present with any impairment. Lastly, the two hypothetical youth may live in homes with vastly different norms and rules around digital media usage, further contextualising the nature of their difficulties. Such complexities punctuate the obvious need to move beyond screen time as a meaningful metric, and towards multipurpose measurements that consider digital media usage across layers of analysis.

RESULTS: GREY LITERATURE SOURCES

Selection of sources of evidence

The primary source collection yielded 28 grey literature sources from knowledge experts and handsearching of organisations within the domain of digital media and child development. Sources were screened for duplicates and three were removed. Due to the nature of the grey literature, title and abstract screening was omitted, and full-text review was completed exclusively. After review, 11 sources failed to meet the inclusion criteria and were removed from the study. Reasons for inclusion included: source was published outside of inclusion dates (7), the tool(s) measured factors outside the scope of the present review (eg, news exposure; 3), or the source failed to develop a measurement tool of digital media use (1). Following exclusions, 14 grey literature sources were evaluated as meeting our inclusion criteria and were included in the study. From these, 17 measurement tools were identified. Reference information for all final included sources is listed in online supplemental appendix E.

Characteristics of sources of evidence

Grey literature sources' information is listed in online supplemental appendix C, table 1, with measurement tool information listed in online supplemental appendix C, table 2. Again, "Source #"is matched across tables.

Study characteristics

All the selected grey literature publications were agency or institutional reports with attached questionnaires, with the exception of one source being solely a questionnaire. Therefore, 13 independent studies were identified across 14 grey literature sources. The majority of sources collected data in the USA (78.57%), were conducted online (71.43%), and used quantitative data analysis (78.57%), and national survey methodology (92.86%). Study characteristics are listed in online supplemental appendix C, table 1.

Population demographics

Sample size ranged from 743 to 4594 participants, with a mean sample size of 1630. One source did not report sample size. No mean age of participants was reported across all grey literature sources. However, the dominant age demographic assessed was adolescence (71.43%). The majority of reports did not describe race or ethnicity of participants (67.86%). Of those that did (32.14%), similar representations of race were reported (i.e., predominantly White, followed by Hispanic, then Black). Half (50%) of sources reported on a sample diverse in socioeconomic status, with majority of assessments constructed by the authors (64.29%). All reported recruitment methods were direct recruitment of unknown participants (85.71%), with the remaining sources failing to mention recruitment methodology.

Critical appraisal within sources of evidence

Almost all the included grey literature sources were assessed as having low risk of bias (92.86%), with the remaining source determined to be of moderate risk due to a lack of information (the source was solely a questionnaire).

Results of individual sources of evidence

Information on the measurement tools identified in the grey literature sources is listed in online supplemental appendix C, table 2. All grey literature sources did not explicitly discuss strengths and limitations of their measurement tools.

Digital media characteristics

Social media usage was the most assessed digital media type (92.85%). Other common types of digital media (e.g., video games, communication, TV/video streaming, and internet use) were all assessed in majority of sources

(71.43%–78.57%). Online supplemental appendix C, table 2 lists all digital media types measured in each source. Unlike the database sources, the grey literature measured aspects of digital media use related to apps, art creation and work/schoolwork. Cellphone/smartphone was the most assessed device (92.85%), followed by laptops (64.29%), tablets (57.14%), and gaming consoles (57.14%). The grey literature sources also assessed smart toys (21.43%), which were not measured in the database sources.

Regarding usage characteristics, the following were investigated: active and sedentary use (7.14%), online use (100%), offline use (85.71%), solitary and shared use (7.14%), educational content (50%) and productive and consumptive use (71.43%). Measurement of specific website and application usage was largely unreported (50%). Assessments of Snapchat and Instagram use were the most prevalent (42.86% each). The grey literature also investigated distinct streaming services (as opposed to a collapsed category) and specific kids' gaming sites. These areas and applications were not assessed in the database sources.

Characteristics of measurement tools

All the grey literature measurement tools were universal and validated in the context of basic survey methodology (100%). For respondents, self-report was most prominent, existing in seven sources (78.57%), of which four sources (28.57%) also included parent-reporting in some form. The remaining three sources (21.43%) collected responses from parents only. Psychometric properties of the measurement tools were not discussed in any of the grey literature sources.

DISCUSSION

Summary of evidence

The purpose of this scoping review was to evaluate extant measures of digital media use and related constructs in children and adolescents, while highlighting important areas for growth and advancement in the domain of digital media measurement in developmental science. Two key findings emerged. First, many measures exist that are mostly individual or caregiver report, particularly for adolescents and young adults, with a focus on problematic digital media overuse. Second, our findings speak to the need for an integrative suite of high-quality instruments that are widely used across research laboratories and methodological settings, specifically in regard to tools that are multilevel (consider digital media use across the developmental ecology), multi-method (include self-report and other forms of data capture), and multi-informant (assess the perspectives of multiple persons, including the discrepancy between child and adult perspectives as being clinically informative).

There have been numerous calls for advancement in the measurement domain for developmental media research.[16–18] Findings from the present scoping review have clearly delineated the nature and extent of this problem. Researchers should be applauded for advancing the field to its present form, largely through the employment of caregiver and self-report measures of "amount" of digital media use or problematic use, and in the context of advanced inferential statistical models—the kinds frequently used in public health, epidemiology, psychology and other areas of the medical and social sciences. Similar advances have been observed in developmental science, particularly with the usage of clever observational and laboratory paradigms.[29 30] That being said, the field appears to be approaching an impasse. It is unlikely that replicable discoveries will emerge from an area where there is such little consensus around appropriate measurement methodology, including fundamentals of psychometric theory such as content and construct validity. Thus, the 30 authors of this review process, along with all members of the workgroup, call for the development of a widely employed set of instruments that can be used across multiple laboratories, including those with disparate views around the risks and benefits of digital media usage.

Large scale and centrally funded consensus exercises in construct validity and psychometric measurement have been employed elsewhere in developmental science and psychiatry. The result of these frameworks has been a high level and constructive debate that supersedes the methodology of any study (or investigator), and instead integrates studies and (non-)replication into a meaningful and coherent scientific dialogue. For example, the Research Domain Criteria championed by the National Institutes of Mental Health have advanced the fields of psychiatry and neuropsychology beyond that of the DSM framework. Relatedly, and perhaps more specific to the present review of measures, the National Institutes of Health (NIH) demonstrated outstanding leadership in the funding and development of a series of state-of-the-art psychometric tools in the NIH Toolbox and related suites of instruments. The comprehensive development and maintenance of these instruments has been championed by healthmeasures.net via NIH funding mechanisms. Given the success of these instruments, the members of the MIST call for a similar exercise in the domain of digital media use, particularly in childhood and adolescence, but also across the life course. To support this initiative, the strengths and limitations of the present measures are described.

Strengths and limitations of measures

The most obvious area of strength for the existing measures is face validity. This likely stems from the major concerns among professionals, parents, and the public with regard to the amount of media being consumed or used by young people. Accordingly, investigators have demonstrated considerable zeal in tackling issues pertaining to the frequency and duration of media use, in general, in addition to pathological behavioural repertoires that putatively emerge in the context of such

usage patterns. Moreover, these self-report and caregiver report instruments have demonstrated highly feasible. The use of traditional survey responses (including Likert scales) in the context of study protocols has allowed the field to advance in terms of the number of researchers and studies employing these methods. That said, there is often a tradeoff between measurement feasibility and quality. Thus, the reviewed instruments perform poorer in terms of content and construct validity.

Excepting the examination of online versus offline use, which is a more recent undertaking, many tools do not explore critical domains such as active vs sedentary, shared vs solitary (e.g., coviewing, social video game play), and productive or consumptive use. Indeed, the measurement of many studies (including some of the authors') would not satisfactorily disambiguate 1 hour of playing a first-person shooter game, from computer programming for leisure, from homework on a computer. There are also distinctions that may fall on disciplinary lines and biases (e.g., paediatricians, clinical psychologists and psychiatrists who have been concerned with problematic overuse due to real-life clinical encounters informing research, compared with educational psychologists and researchers of pedagogy who are interested in media for learning). Of great relevance to the reductionist dispute surrounding whether digital media is harmful or helpful, educational content or other development-enhancing content is largely omitted in the measures that were included in the present scoping review.

Another construct validity issue from the current study has emerged in the realm of behavioural addictions. There have been several recent commentaries to better consider digital media and internet overuse, including a recent proposal for distinguishing a "primarily mobile" from a "non-mobile" internet addiction.[31 32] While not the focus of the present study, most measurement tools explored clinical diagnoses (e.g., internet addiction) or risk factors based on symptomology required for disordered use.[33–35] There appeared to be a spectrum of labelling from less severe (internet misuse, excessive internet use) to clinically significant and more severe behavioural addictions (i.e., internet addiction, IGD); however, usage and interpretation of diagnostic criteria varied considerably throughout the literature and cut offs were diverse and debated. Additionally, certain assessment items were open to individual interpretation. For example, it was common for sources to define addiction based on a concept surrounding the digital media usage exceeding the individual's intended use. As has long been the case in developmental psychology and developmental psychopathology, there is an ongoing need to differentiate typical (or normal) behavioural and phenotypic variation from atypical (or abnormal) presentations and impairment. The utilisation of instruments that are sensitive to variation both within and between diagnostic categories will be essential.

Regarding the measurement tools used to assess digital media usage, the majority of tools were quantitative and universal.[33 36–39] As mentioned above, these measurement tools predominantly targeted frequency-based aspects of usage.[40–42] Despite the prevailing uses of digital media being social connection and entertainment, there was a paucity of tools specifically developed and validated to assess social media usage, communication, e-books and (perhaps less surprisingly) virtual reality.[43–45] With the increasing popularity of these digital media activities, the assessment and investigation of these forms of usage must be more strongly developed. Furthermore, while numerous measurement tools were cross-culturally and linguistically validated, a relative dearth of demographic considerations in the literature surrounding race, ethnicity, socioeconomic status, and gender, prompts some concern, as well.[38 46 47] Given the replicated finding of children and youth far exceeding the guidelines for daily digital media usage,[48 49] psychometric developments may also benefit from the development of norms surrounding regular and problematic usage. Additionally, the lack of specificity regarding the device type could also complicate measurement and conceptualisation if not sufficiently understood and considered.

The widespread utilisation of self-reported surveys was not surprising. While this method is accessible, cost-effective and simple, it opens assessments to many well-known biases such as social desirability, recall bias, and other validity concerns (e.g., people simply being unaware of how much media is used personally or by children, or reports of amount of screen time being systematically linked to other criterion variables). Standardised self-report procedures and norms may help offset this problem. However, it is likely that the greatest advances will involve developments in data capture, including automated data collection from devices or another software solutions such as computer vision, ecological momentary assessment, wearables, or a hybrid of these technologies. Very few studies utilised automated statistics,[43 50–52] though there is a slow and steady uptake in the development of these assessment tools.[29 30] Challenges to their widespread adoption include data storage and privacy concerns—issues not faced in the same manner by big technology companies. Increased employment of this methodology could increase reliability. One study used ecological momentary assessment to evaluate digital media usage.[53] However, further advancements in this domain are warranted, particularly in the development of convenient tools that are less cumbersome to the user.

Limitations

Some strengths of the present study were: (1) a novel approach, focusing on source methodology for data extraction with a specific emphasis on tools for measuring digital media use; (2) the inclusion of sources that were predominantly low risk; (3) the inclusion of measurement tools that were largely reliable and valid, (4) the use of a robust coding system in the study review and data extraction stages, and (5) the importance of objectives, that is, scoping the literature around measurement for

digital media usage. This scoping review also had some limitations. First, due to the constantly evolving nature of digital media, sources published prior to March 2014 were excluded from the study. While this exclusion is thought to have minimal impact on the scoping review, since the focus was on a modern conceptualisation of digital media usage, researchers interested in earlier digital media use may need to consult additional resources. Second, data extraction and coding were inevitably delayed by the COVID-19 pandemic. Third, a large portion of the studies included employed potentially biased recruitment techniques. Lastly, this scoping review is obviously limited by the available literature. Given the rapidly evolving technological landscape, there will be an ongoing need for scientists and clinicians to stay abreast of measurement development, especially as technology changes. Thus, it is recommended that a similar scoping review exercise be conducted every few years for the foreseeable future.

Conclusions

Despite burgeoning programmes of research in laboratories across the world, the concept of digital media use in young people still warrants further explication and clarification. Many meritorious assessment tools have been created to assess constructs pertaining digital media overuse, though there remain important areas that are overlooked, oversimplified or understudied. Future research would clearly benefit from moving beyond "screen time", allowing exploration on the different types of usage across devices, platforms and contexts, for better or for worse. Integrating theoretical frameworks from elsewhere in developmental science is essential, including moving beyond the use of screen time as a relevant variable, to considering how children grow up in a multilevel ecology that includes a digital level of analysis, among others. The modern technological landscape is ripe with challenges surrounding measurement, which are only compounded by challenges in developmental science, generally. At the same time, measurement solutions developed in this domain will likely propagate across the medical, psychological and social sciences. It is the hope of the authors that this scoping review represents an interim "taking stock" of a relatively young discipline that has already accomplished much, while being mindful of the significant work ahead. More specifically, these findings may help inform further research and the creation of a consensus based, psychometrically robust, digital media toolkit that is simultaneously comprehensive and feasible for researchers and clinicians, alike.

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Acknowledgements We would like to acknowledge the efforts of all the Research Assistants in the Whole Family Lab at the University of Waterloo (Waterloo, Canada) for their assistance in data collection. We would also like to thank Children & Screens: Institute of Digital Media and Child Development for supporting this project and the Media Impact Screening Toolkit (MIST) Workgroup.

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Contributors DTB obtained funding, conceptualised the research, oversaw data collection and analyses, and edited the manuscript. SSMay conceptualised the research, conducted data collection and analyses, drafted and edited the manuscript. LC conducted data collection and analyses, drafted and edited the manuscript. PH-DP obtained funding, conceptualised the research, and edited the manuscript. DC, TA, LH, KD-H, JAE, AGF, SMad, GP, H-JR, DT, SU, JS, RN, HP conceptualised the research and edited the manuscript. The MIST Working Group conceptualised the research and edited the manuscript. All authors were involved in the decision to submit the manuscript for publication and approved the final manuscript.

Funding Funding for this research project was provided by Children and Screens: Institute of Digital Media and Child Development (grant/award number: not applicable). The project was conceptualized, stewarded, and funded by Children and Screens as part of an effort to develop a Media Impact Screening Toolkit for clinicians and researchers; as such, Dr. PHDP (fourth author) represents the organization as an active member of the article authorship team.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval This project did not involve living human or animal participants, or human or animal biological materials, and therefore did not require ethics review and approval by a research ethics board.

Provenance and peer review Not commissioned; externally peer reviewed.

Data availability statement Data are available on reasonable request. All data relevant to the study are included in the article or uploaded as online supplemental information. Relevant data are included as online supplemental information. Extended data available by request.

terminology, drug names and drug dosages), and is not responsible for any error and/or omissions arising from translation and adaptation or otherwise.

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Appendix A - Search Strategy (MEDLINE)

Database: Ovid MEDLINE, Ahead of Print, In-Process & Other Non-Indexed Citations and Daily <March 1 2014 to March 1 2019>

30	(infant* or infancy or baby or babies or newborn* or new born* or neonat* or toddler* or preschooler* or child* or boy or boys or girl or girls or pediatric* or preteen or adolescen* or youth or teen or teens or teenager*).ti,ab,kw. or exp infant/ or exp child/ or adolescent/
31	(Screen time or Screentime or Screen viewing or Screen usage or "screen use" or "screen media use" or "screen digital media use").ti,ab,kw. or screen time/
32*	((Digital media or Digital activity or Screen media or Electronic media or interactive media or Cell phone* or cellphone* or Smartphone* or Smart phone* or Tablet* or Ipad or I pad or mobile device* or Mobile technology or Digital technology or Mobile phone* or I phone* or Iphone* or Television* or Tv or Dvd or dvds or youtube or Netflix or Instagram or facebook or snapchat or hulu or Social media or screen media or Smart device* or Digital device* or Videogame* or video game* or Video gaming or Video console* or Xbox or X box or Playstation or Wii or Nintendo or Video streaming or virtual reality or augmented reality or Web browsing or internet or computer* or handheld or laptop* or electronic gam*) adj2 ("use" or usage or overuse or view* or watch or play* or exposure)).ti,ab,kw.

33	(time or frequency or hour or hours or daily or week or day or monitor or monitoring).ti,ab,kw. or time factors/
34	32 and 33
35	(measurement or measuring or measure or assessment* or screening or scale or scales or inventory or tool or tools or test or tests or poll or polls or polling or survey* or questionnaire* or interview* or self report* or child report* or parent report* or teaching report* or recording or monitor or monitoring or naturalistic or observational stud* or observational method* or nationally representative sample or probability sample).ti,ab,kw.
36	"surveys and questionnaires"/ or Self report/ or Interviews as topic/ or observational studies as topic/ or Observational study.pt.
37	35 or 36
38	31 or 34
39	30 and 37 and 38
40	limit 39 to english language
41	40 not (review or editorial or letter or comment).pt.
42	41 not (exp animals/ not humans/)+
43	limit 42 to yr="2007 -Current"
44	limit 42 to yr="2014 -Current"

* Because the MeSH heading “screen time” has only been in use since 2019, we have created a keyword search strategy to capture articles in which researchers assess the time spent on digital media use without using the phrase “screen time”.

Appendix B – Database Sources

Table 1. Study Characteristics – Database Sources

Measurement Tool	Acronym	Source #	Authors (Year)	Study Setting	Total Sample Size	Sample Age Group(s)	Race	SES - Index	Study Paradigm	Risk of Bias	Notes
Addiction Profile Index Internet Addiction Form	APIINT	1	Ogel, Karadag, Satgan & Koc (2015)	Unknown	154	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	High	
Adolescent Health Promotion Short Form	AHP-SF	2	Chen, Lai & Gaete (2014)	School	814	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
Adolescent Preoccupation with Screens Scale	APSS	3	Hunter et al. (2017)	Online	1952	School Age Adolescence	Unknown	Diverse SES - Common Index	Survey (local)	Low	
Battery Use Screenshot	BUS	4	Gower & Moreno (2018)	Online	1156	School Age Adolescence	Unknown	Not Specified	Survey (local)	Low	
Behavioral Addiction Measure Video Gaming	BAM-VG	5	Sanders & Williams (2016)	Online	506	Young Adults	Unknown	Diverse SES - Common Index	Survey (local)	Low	Target Population: People who play video games regularly
Bergen Facebook Addiction Scale	BFAS	6	Pontes, Andreassen & Griffiths (2016)	School & Online	495	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
Bergen Social Media Addiction Scale	BSMAS	7a	Lin, Broström, Nilsen, Griffiths & Pakpour (2017)	School	2676	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		8	Monacis, de Palo, Griffiths, & Sinatra (2017)	School	734	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
Chen Internet Addiction Scale - Revised	CIAS-R	9a	Mak et al. (2014)	School	860	Adolescence Young Adults	100% East Asian	Not Specified	Survey (local)	Moderate	
Chinese Social Media Addiction Scale		10	Liu & Ma (2018)	School	619	Adolescence Young Adults	100% East Asian	Not Specified	Survey (local)	Moderate	Target Population: Chinese Youth
Clinical Video game Addiction Test 2.0	C-VAT 2.0	11	van Rooij, Schoenmakers & van de Mheen (2015)	Clinic	32	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
Compulsive Internet Use Scale	CIUS	12a	Dhir, Chen & Nieminen (2015a)	School	425	Adolescence Young Adults	100% East Asian	Diverse SES - Author's Scale	Survey (local)	Low	
		13	Dhir, Chen & Nieminen (2015b)	School	3693	School Age Adolescence Young Adults	100% South Asian	Diverse SES - Author's Scale	Survey (local)	Low	
		14	Dhir, Chen & Nieminen (2016)	School	2383	School Age Adolescence Young Adults	100% South Asian	High/Middle SES - Author's Scale	Survey (local)	High	
		15	Guertler et al. (2014a)	In-Home	8132	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		16	Guertler et al. (2014b)	Clinic & In-Home	292	Adolescence Young Adults	91% White	Not Specified	Survey (local) & Interview	Low	

		17b	Jeromin, Rief & Barke (2016)	Online	894	Young Adults	Unknown	Not Specified	Survey (local)	Low	Target Population: Internet Gamers
		18b	Siciliano, Bastiani, Mezzasalma, Thanki, Curzio & Molinaro (2015)	School	21205	Adolescence Young Adults	Unknown	Not Specified	Secondary Data Analysis, National Survey	Low	
		19	Yong, Inoue & Kawakami (2017)	Online	623	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		20	Wartberg, Petersen, Kammerl, Rosenkranz & Thomasius (2014)	Unknown	1723	Adolescence	Unknown	Not Specified	Survey (local) & Interview	Low	
Content-based Media Exposure Scale	C-ME	21	den Hamer, Konijn, Plaisier, Keijer, Krabbendam & Bushman (2017)	School	2164	School Age Adolescence Young Adults	Unknown	Diverse SES - Author's Scale	Survey (local)	Low	
Diagnostic Classification Test for Internet Addiction	DCT-IA	22	Tu, Gao, Wang & Cai (2017)	Unknown	1558	School Age Adolescence Young Adults	Unknown	Not Specified	Unknown/Unclear	Moderate	
Excessive Internet Use Scale	EIU	23	Škařupová, Ólafsson & Blinka (2015)	Online	18709	Adolescence	Unknown	Not Specified	Secondary Data Analysis, National Survey	Low	
Food, Health, and Choices Questionnaire	FHC-Q	24	Gray, Koch, Contento, Bandelli, Ang & Noia (2016)	School	221	School Age	69% Hispanic 27% Black	Low SES - Author's Scale	Survey (local)	Low	
Game Addiction Identification Test	GAIT	25	Vadlin, Aslund, Rehn & Nilsson (2015)	Online & Unknown (Paper survey)	1877	Adolescence	Unknown	Diverse SES - Common Index	Survey (local)	Low	
Game Addiction Scale	GAS	26	Gaetan, Bonnet, Brejard & Cury (2014)	Online & School	465	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		27	Lemos, Cardoso & Sougey (2016)	School	384	Young Adults	Unknown	Not Specified	Survey (local)	Low	Target Population: Gamers
		28	Brunborg, Hanss, Mentzoni, & Pallesen (2015)	In-Home & Online	3037	Adolescence Young Adults	Unknown	Not Specified	National Survey	Low	
		29	Sahin, Gumus & Dincel (2016)	Online	370	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
Generalized Problematic Internet Use Scale 2	GPIU2	30	Assunção & Matos (2017)	School	761	Adolescence Young Adults	Unknown	Diverse SES - Common Index	Survey (local)	Low	
		31	Pontes, Caplan & Griffiths (2016)	Online	622	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		32a	Laconi, Kaliszewska-Czeremska, Tricard, Chabrol & Kuss (2018)	School & Online	563	Young Adults	Unknown	Not Specified	Survey (local)	Moderate	

Healthy Computing Questionnaire for Children	HCQC	33	Hatfield, Parsons, Ciccarelli (2016)	School	440	School Age	Unknown	Not Specified	Survey (local)	High	
Healthy Living for Kids Survey	HLKS	34	Quelly (2018)	School	88	School Age	66% White 12% Hispanic 9% Mixed Race	Not Specified	Survey (local)	High	
Implicit Association Test		35	Roh, Bhang, Choi, Kweon, Lee & Potenza (2018)	Clinic & Hospital Based Research Centre	78	School Age Adolescence	100% East Asian	Not Specified	Survey (local)	Low	Target Population: Treatment-seeking children with Internet addiction and/or smart-phone overuse
Internet Abusive Use Questionnaire	IAUQ	36	Calvo-Francés (2016)	Online	908	Adolescence Young Adults	Unknown	Not Specified	National Survey	Low	
Internet Addiction Diagnostic Questionnaire	IADQ	37a	Boysan, Kuss, Barut, Ayköse, Güleç & Özdemir (2015)	School	455	Young Adults	Unknown	High/Middle SES - Author's Scale	Survey (local)	High	
Internet Addiction Scale	IAS	41	Cho et al. (2014)	School	1192	Adolescence	Unknown	Diverse SES - Author's Scale	Survey (local)	Moderate	
Internet Addiction Test	IAT	9b	Mak et al. (2014)	School	860	Adolescence Young Adults	100% East Asian	Not Specified	Survey (local)	Moderate	
		12b	Dhir, Chen & Nieminen (2015a)	School	425	Adolescence Young Adults	100% East Asian	Diverse SES - Author's Scale	Survey (local)	Low	
		32b	Laconi, Kaliszewska-Czeremska, Tricard, Chabrol & Kuss (2018)	School & Online	563	Young Adults	Unknown	Not Specified	Survey (local)	High	
		37b	Boysan, Kuss, Barut, Ayköse, Güleç & Özdemir (2015)	School	455	Young Adults	Unknown	High/Middle SES - Author's Scale	Survey (local)	High	
		38	Ahmad, Alzayyat, Al-Gamal (2015)	School	587	Adolescence Young Adults	Unknown	Diverse SES - Author's Scale	Survey (local)	Low	
		39b	Baggio, Iglesias, Berchtold & Suris (2017)	School & Online	3067	Adolescence	Unknown	High/Middle SES - Author's Scale	National Survey	Low	
		40a	Chin & Leung (2018)	School	1072	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		42	Dhir, Chen & Nieminen (2015c)	School	1914	School Age Adolescence Young Adults	100% South Asian	Not Specified	Survey (local)	Moderate	
		43	Fernández-Villa, Molina, García-Martín, Llorca,Delgado-Rodríguez & Martín (2015)	Online	981	Young Adults	Unknown	Not Specified	Survey (local)	Low	
		44	Fioravanti & Casale (2015)	School	840	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		45	Lai et al. (2015)	School	2535	School Age	62% East Asian	Not Specified	National Survey	High	

					Adolescence Young Adults	38% Southeast Asian				
		46	Hawi, Blachnio & Przepiorka (2015)	Online	1297	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	High	
		47	Kaya, Delen & Young (2016)	School	990	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		48	Monacis, de Palo, Griffiths, & Sinatra (2016)	School, Gaming halls	687	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		49	Pontes, Patrão & Griffiths (2014)	School & Online	593	Adolescence Young Adults	94% White	Not Specified	Survey (local)	Low	
		50	Tsimtsiou, Haidich, Kokkali, Dardavesis, Young & Arvanitidou (2014)	School	151	Young Adults	Unknown	Not Specified	Survey (local)	High	
		51	Waqas et al. (2018)	School	522	Adolescence Young Adults	100% South Asian	Not Specified	Survey (local)	Low	
	IAT-A	52	Teo & Kam (2014)	School & Online	325	School Age Adolescence	Unknown	Not Specified	Survey (local)	Low	
	s-IAT-sex	53	Wéry, Burnay & Billieux (2015)	Online	401	Young Adults	Unknown	Not Specified	Survey (local)	Low	
Internet Addiction Test - Short Version	s-IAT	54	Tran et al. (2017)	Online	589	Adolescence Young Adults	100% Southeast Asian	Diverse SES - Author's Scale	Survey (local)	Low	
Internet Disorder Scale	IDS-15	55	Pontes & Griffiths (2017)	Online	1094	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
Internet Gaming Disorder Questionnaire	IGDQ	17a	Jeromin, Rief & Barke (2016)	Online	894	Young Adults	Unknown	Not Specified	Survey (local)	Low	
Internet Gaming Disorder Scale	IGDS	56c	Evren, Dalbudakb, Topcu, Kutlu, Evren & Pontes (2018)	Online	1250	Young Adults	Unknown	Not Specified	Survey (local)	Low	
		57	Lemmens, Valkenburg & Gentile (2015)	Online	2444	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		58	Wartberg, Zieglmeier & Kammerl (2019)	In-Home	985	School Age Adolescence	Unknown	Not Specified	Survey (local)	Low	
Internet Gaming Disorder Scale - Short Form	IGDS9-SF	7b	Lin, Broström, Nilsen, Griffiths & Pakpour (2017)	School	2676	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		56a	Evren, Dalbudakb, Topcu, Kutlu, Evren & Pontes (2018)	Online	1250	Young Adults	Unknown	Not Specified	Survey (local)	Low	
		59	Pontes & Griffiths (2015)	Online	1060	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	Target Population: Gamers
		60	Wu, Lin, Årestedt, Griffiths, Broström & Pakpour (2017)	School	2363	School Age Adolescence Young Adults	100% Middle Eastern	Not Specified	Survey (local)	Low	
		61	Schivinski, Brzozowska-Woś, Buchanan, Griffiths & Pontes (2018)	Online	3222	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	

		62	Pontes & Griffiths (2016)	School & Online	495	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low
		63	Pontes, Macur & Griffiths (2016)	School	1071	School Age Adolescence	Unknown	Not Specified	Survey (local)	Low
Internet Gaming Disorder Test 10	IGDT-10	65a	Király, Sleczka, Pontes, Urbán, Griffiths & Demetrovics (2017)	Online	4887	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Moderate
Internet Gaming Disorder Test 20	IGD-20	64	Hawi & Samaha (2017)	School	375	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Moderate
		66	Pontes, Kiraly, Demetrovics & Griffiths (2014)	Online	1003	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low
		67	Fuster, Carbonell, Pontes & Griffiths (2016)	Online	1074	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	High
Internet Gratification Scale for Adolescents		68	Dihr, Chen & Nieminen (2017)	School	1914	School Age Adolescence Young Adults	100% South Asian	Diverse SES - Unknown	Survey (local)	Low
Internet Motive Questionnaire for Adolescents	IMQ-A	69	Bischof-Kastner, Kuntsche & Wolstein (2014)	In-Home & School	101	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low
Korean Scale for Internet Addiction	K-Scale	70	Mak et al. (2017)	School	589	Adolescence Young Adults	100% East Asian	Not Specified	Survey (local)	Moderate
Korean Smartphone Addiction Proneness Scale		71	Kim, Lee, Lee, Nam & Chung (2014)	Unknown	795	School Age Adolescence Young Adults	Unknown	Not Specified	National Survey	Low
Media and Technology Usage and Attitudes Scale	MTUAS	72b	Cocoradă, Ioan Maican, Cazan & Maican (2018)	School	717	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low
Mobile Phone Addiction Craving Scale		74a	De-Sola, Talledo, Rubio, & de Fonseca (2017)	Online	1126	Adolescence Young Adults	Unknown	Not Specified	National Survey	Low
Mobile Phone Dependence Questionnaire	MPDQ	40b	Chin & Leung (2018)	School	1072	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low
		75	Leung (2017)	School	733	School Age Adolescence	100% East Asian	Diverse SES - Unknown	Survey (local) & Focus Group	Moderate
Mobile Phone Involvement Questionnaire		76b	Lin, Griffiths & Pakpour (2018)	School	3216	Adolescence Young Adults	Unknown	High/Middle SES	Survey (local)	Low
Mobile Phone Problem Use Scale	MPPUS	74b	De-Sola, Talledo, Rubio, & de Fonseca (2017)	Online	1126	Adolescence Young Adults	Unknown	Not Specified	National Survey	Low
		77a	Andrews, Ellis, Shaw & Piwek (2015)	In-Home	23	Young Adults	Unknown	Not Specified	Survey (local)	Low
		78a	Lopez-Fernandez, Honrubia-Serrano, Freixa-Blanxart & Gibson (2014)	School	1529	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Moderate
Mobile Phone Problem Use Scale - Short Form	MPPUS-10	79	Foerster, Roser, Schoeni & Röösli (2015)	School	412	School Age Adolescence	Unknown	Not Specified	Survey (local)	Low
Online Cognition Scale	OCS	80	Blachnio, Przepiórka & Hawi (2015)	Online	626	School Age Adolescence	Unknown	Not Specified	Survey (local)	Low

					Young Adults					
		81	Komnenić, Filipović & Vukosavljević-Gvozden (2015)	Online	254	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	High	
Online Gaming Addiction Scale	OGAS	82	Başol & Bedir Kaya (2018)	Unknown	327	Adolescence	Unknown	Not Specified	Survey (local)	Low	Target Population: People who play MMORPGs (Massively Multiplayer Online Role Playing Games)
Out-Of-School Nutrition and Physical Activity - Observational Practice Assessment Tool	OSNAP-OPAT	83	Lee et al. (2014)	After-school program	884	School Age	Unknown	Not Specified	Naturalistic Observation	High	
Parents Role in Establishing healthy Physical Activity and Sedentary behaviour habits questionnaire	PREPS	84	Carson, Hesketh, Rhodes, Rinaldi, Rodgers & Spence (2017)	Clinic & In-Home	118	Infancy Preschool Age	58% White 15% East Asian	Diverse SES	Survey (local)	Low	Target Population: Parents with ambulatory toddlers
Persian Nomophobia Questionnaire	NMP-Q	76a	Lin, Griffiths & Pakpour (2018)	School	3216	Adolescence Young Adults	Unknown	High/Middle SES	Survey (local)	Low	
Problem Videogame Playing Scale	PVP	85	Tejeiro, Espada, Gonzálvez & Christiansen (2016)	School	909	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		78b	Lopez-Fernandez, Honrubia-Serrano, Baguley & Griffiths (2014)	Unknown	2356	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
Problematic and Risky Internet Use Screening Scale	PRIUSS	87	Moreno, Arseniev-Koehler & Selkie (2016)	School	1079	Adolescence Young Adults	82% White 8% East Asian 5% Black	Not Specified	Survey (local)	Low	
Problematic Facebook Use Scale	PFUS	88	Marino, Vieno, Altoè & Spada (2017)	School	1460	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	Target Population: Facebook Users
Problematic Internet Entertainment Use Scale for Adolescents	PIEUSA	78c	Lopez-Fernandez, Honrubia-Serrano, Gibson & Griffiths (2014)	School	1097	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
Problematic Internet Use Questionnaire	PIUQ	90	El Asam, Samara & Terry (2019)	School	1814	School Age Adolescence	Unknown	Not Specified	Survey (local)	Low	
Problematic Internet Use Questionnaire - Short Form	PIUQ-SF	91	Li, Diez & Zhao (2019)	School	235	Adolescence Young Adults	69% Black 27% Hispanic	Not Specified - Common Index	Survey (local)	High	
Problematic Internet Use Scale	PIUS	92	Boubeta, Salgado, Folgar, Gallego & Mallou (2015)	School	1709	School Age Adolescence	100% Hispanic	Not Specified	Survey (local)	High	

Problematic Mobile Phone Use Questionnaire Revised	PMPU-Q-R	93	Kuss, Harkin, Kanjo & Billieux (2018)	Online & Focus Groups	512	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Moderate	
Problematic Online Gaming Questionnaire	POGQ	65b	Király, Sleczka, Pontes, Urbán, Griffiths & Demetrovics (2017)	Online	4887	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Moderate	
		94	Smohai et al. (2017)	School & Online	1964	Adolescence	Unknown	Not Specified	Survey (local)	Low	Target Population: Individuals with problematic online gaming
Problematic Social Networking Services Use Scale	PSUS	95	Lou, Liu & Liu (2017)	School	1030	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	High	
Psycho-Social Aspects of Facebook Use	PSAFU	96	Bodroža & Jovanovic (2016)	Online	804	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	High	
Radio-Frequency Identification	RFID	97	Alahmadi (2015)	In-Home	7	School Age	Unknown	Not Specified	Naturalistic Observation	High	
Risk of Addiction to Social Networks Scale	CrARS	98	Vilca & Vallejos (2015)	School	205	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
Sedentary Behaviour Questionnaires		99	Busschaert, De Bourdeaudhuij, Van Holle, Chastin, Cardon & De Cocker (2015)	In-Home & School	221	Adolescence Young Adults	Unknown	Diverse SES - Author's Scale	Survey (local) & Experience Sampling (EMA)	High	
Short Problematic Internet Use Test	SPIUT	18a	Siciliano, Bastiani, Mezzasalma, Thanki, Curzio & Molinaro (2015)	School	21205	Adolescence Young Adults	Unknown	Not Specified	Secondary Data Analysis,National Survey	Low	
Short Social Media Disorder Scale		100b	van den Eijnden, Lemmens & Valkenburg (2016)	Online	2198	School Age Adolescence	Unknown	Not Specified	Survey (local)	Low	
Smartphone Addiction Inventory	SPAI	101	Khoury, de Freitas, Roque, Rodrigues Albuquerque, de Castro Lourenço das Neves & Garcia (2017)	School	415	Young Adults	Unknown	Not Specified	Survey (local)	High	
		102	Pavia, Cavani, Di Blasi & Giordano (2016)	School	485	Young Adults	100% White	Not Specified	Survey (local)	Low	
		103	Simó-Sanz, Ballestar-Tarín & Martínez-Sabater (2018)	Online	2958	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		104	Wang, Sigerson, Jiang & Cheng (2018)	School	463	Young Adults	100% East Asian	Not Specified	Survey (local)	Low	
Smartphone Addiction Scale	SAS	105	Demirci, Orhan, Demirdas, Akpinar & Sert (2014)	School	301	Young Adults	Unknown	Not Specified	Survey (local)	Low	
		106a	Sfendla, Laita, Nejjar, Souirti, Touhami & Senhaji (2018)	Online	750	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
Smartphone Addiction Scale - Short Version	SAS-SV	72a	Cocoradă, Ioan Maica, Cazan & Maican (2018)	School	717	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	

		106b	Sfendla, Laita, Nejjar, Souirti, Touhami & Senhaji (2018)	Online	750	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
		107	Luk et al. (2018)	In-Home	3211	Young Adults	100% East Asian	Diverse SES - Author's Scale	Survey (local)	Low	
		108	Tateno, Kim, Teo, Skokauskas, Guerrero & Kato (2019)	School	573	Young Adults	Unknown	Not Specified	Survey (local)	Low	Target Population: Japanese Speaking Individuals
Social Media Disorder Scale	SMD	100a	van den Eijnden, Lemmens & Valkenburg (2016)	Online	2198	School Age Adolescence	Unknown	Not Specified	Survey (local)	Low	
		109	Savci, Ercengiz & Aysan (2018)	Unknown	553	Adolescence	Unknown	Not Specified	Survey (local)	Low	
Social Networking Activity Intensity Scale	SNAIS	110	Li et al. (2016)	School	1088	School Age Adolescence	100% East Asian	Not Specified	Survey (local)	Low	
Structured Clinical Interview for Internet Gaming Disorder	SCI-IGD	111	Koo, Han, Park & Kwon (2017)	Clinic & Community Setting	236	School Age Adolescence	100% East Asian	Diverse SES - Author's Scale	Survey (local) & Clinical Interview	Low	
Student Laptop Use and Musculoskeletal Posture	SLUMP	112	D'Silva, Cote, Murphy & Barakat-Haddad (2018a)	School	33	Young Adults	Unknown	Not Specified	Survey (local)	Low	
		113	D'Silva, Cote, Murphy & Barakat-Haddad (2018b)	School & Online	179	Young Adults	Unknown	Not Specified	Survey (local)	Low	
Study of Cognition, Adolescents and Mobile Phones	SCAMP	114	Mireku et al. (2018)	School	350	School Age	63% White 12% Mixed Race	Diverse SES	Survey (local)	Moderate	
Technology-Related Psychological Consequences Questionnaire		115	Emelin, Tkhostova & Rasskazova (2014)	Unknown	132	Adolescence Young Adults	Unknown	Not Specified	Survey (local)	Low	
Third-Person Effect Questionnaire & Media Exposure List		73	Hayee & Kamal (2014)	School	328	Adolescence Young Adults	100% South Asian	Not Specified	Survey (local) & Focus Groups	High	
Unnamed		39a	Baggio, Iglesias, Berchtold & Suris (2017)	School & Online	3067	Adolescence	Unknown	High/Middle SES - Author's Scale	National Survey	Low	
		77b	Andrews, Ellis, Shaw & Piwek (2015)	In-Home	23	Young Adults	Unknown	Not Specified	Survey (local)	Low	
		116	Etaher & Weir (2016)	School	128	School Age Adolescence	Unknown	Not Specified	Survey (local)	Moderate	
		117	Cristia & Seidl (2015)	Online	453	Infancy Preschool Age	Unknown	High/Middle SES - Common Index	Survey (local)	Low	
		118	Fikkers, Piotrowski & Valkenburg (2017)	Online	238	School Age Adolescence	Unknown	Not Specified	Survey (local) & Online Diaries	Low	
		119	Holstein et al. (2014)	School	2100	School Age Adolescence	Unknown	Diverse SES - Author's Scale	Survey (local)	Low	
		120	Salgado, Boubeta, Tobío, Mallou, & Couto (2014)	School	2339	School Age Adolescence Young Adults	100% Hispanic	Not Specified	Survey (local)	Low	

		121	Silva, Gunnell & Tremblay (2018)	School	1083	Adolescence Young Adults	100% Hispanic	Not Specified	Survey (local)	Low
		123a	Goedhart et al. (2018)	In-home & Online	587	School Age Adolescence Young Adults	69% Hispanic 27% Black	Not Specified	Survey (local)	Low
Videogame Addiction Scale for Children	VASC	122	Yılmaz, Griffiths & Kan (2017)	School	780	School Age	Unknown	High/Middle SES - Author's Scale	Survey (local)	Low
XMobiSense		123b	Goedhart et al. (2018)	In-home & Online	587	School Age Adolescence Young Adults	69% Hispanic 27% Black	Not Specified	Survey (local) & Experience Sampling (EMA)	Low
Young Diagnostic Questionnaire	YDQ	124	Wartberg et al. (2017)	School	4157	Adolescence	Unknown	Not Specified	Survey (local)	Low
		125	Wartberg, Kriston, Kegel & Thomasius (2016)	In-Home	1000	School Age Adolescence	Unknown	Not Specified	Survey (local)	Low
Young's Internet Addiction Test - Short Form	YIAT-SF	56b	Evren, Dalbudakb, Topcu, Kutlu, Evren & Pontes (2018)	Online	1250	Young Adults	Unknown	Not Specified	Survey (local)	Low
Youth Leisure-Time Sedentary Behaviour Questionnaire	YLSBQ	126	Cabanas-Sánchez, Martínez-Gómez, Esteban-Cornejo, Castro-Piñero, Conde-Caveda & Veiga (2017)	School	1401	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (local) & Physiological Measure (accelerometer)	Low

Table 2. Digital Media Use Measurement Tool Characteristics – Database Sources

Measurement Tool	Acronym	Source #	Measure-ment Type	Informant	Digital Media Device	Media Type	Usage Characteristics	Specific Applications/ Websites	Reliability	Validity	Author Identified Tool Strengths/Limitations	Notes
Addiction Profile Index Internet Addiction Form	APIINT	1	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online Non-Educational Consumptive		Good	Good	Consists of multiple dimensions, including: frequency of internet use, addiction symptoms, impact of internet use on life, craving for internet use, and motivation to reduce internet use.	
Adolescent Health Promotion Short Form	AHP-SF	2	Survey	Self-Report	Television Multi-Screen Composite (Unspecified)	Video Game TV/ Video Streaming	Non-Educational Consumptive		Good	Good	Used multiple methods to establish the tool's validity and reliability, including: construct validity, convergent validity, discriminant validity, and internal consistency.	
Adolescent Preoccupation with Screens Scale	APSS	3	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Video Game Social Media Communication (Texting/Video Chatting) TV/ Video Streaming Internet Browsing eBooks Virtual Reality/ Augmented Reality	Active Sedentary Online Offline Solitary Shared Productive Consumptive		Fair	Good		
Battery Use Screenshot	BUS	4	Automated Statistics	Passive Data Collection	Cellphone/ Smartphone	Mobile Phone Apps	Online Offline		Unknown/ Unclear	Unknown /Unclear		
Behavioral Addiction Measure Video Gaming	BAM-VG	5	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Video Game	Online Offline Non-Educational Consumptive	Facebook	Good	Good	Tested the BAM-VG in a more representative population than prior research including more females and non-problematic video gamers across a wider age range.	

Bergen Facebook Addiction Scale	BFAS	6	Survey	Self-Report	Cellphone/ Smartphone Laptop Tablet Multi-Screen Composite (Unspecified)	Social Media	Sedentary Online	Facebook	Good	Good		Portuguese Version
Bergen Social Media Addiction Scale	BSMAS	7a	Survey	Self-Report	Unknown/ Unclear	Social Media	Online Shared (Online Only)		Good	Good		
		8	Survey	Self-Report	Unknown/ Unclear	Social Media	Online Non-Educational		Good	Good		Italian Version
Chen Internet Addiction Scale - Revised	CIAS-R	9a	Survey	Self-Report	Unknown/ Unclear	General Internet Use	Sedentary Online Non-Educational		Fair	Fair	The poor positive predictive value, but good negative predictive value of CIAS-R further suggest that the CIAS-R is more inclusive in detecting Internet addicted users than the IAT. Believed to be better at identifying those with problematic internet use rather than internet addiction.	
Chinese Social Media Addiction Scale		10	Survey	Self-Report	Unknown/ Unclear	Social Media	Online Non-Educational Consumptive	WeChat QQ Sina Weibo	Good	Good	Measures broad social media addiction compared to other measures. Addresses variables not addressed in the Facebook Addiction Scale. No cut offs for distinguishing addictive from non-addictive users.	Sample population was exclusively college students.
Clinical Video game Addiction Test 2.0	C-VAT 2.0	11	Survey	Clinician-Report	Multi-Screen Composite (Unspecified)	Video Game	Consumptive		Unknown/ Unclear	Unknown /Unclear		

Compulsive Internet Use Scale	CIUS	12a	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online	Good	Good	Brief measure. Measures the severity of the core elements of compulsive internet use. No statistically proven cut off scores for compulsive and non-compulsive internet use.	
		13	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online	Unknown/ Unclear	Unknown /Unclear	Validated for use in private and public school settings.	
		14	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online	Good	Good	More suitable for research and clinical applications compare to other measures in the field. Economically advantaged due to its short length and ease of use allowing the tool to be administered online.	
		15	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online	Good	Good		
		16	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online	Fair	Good	Cut offs for Internet Addiction are not well validated. Strongly varying factor structures for the IAT are found in research. This study supported the six-factor structure.	
		17b	Survey Automated Statistics	Self-Report Joint Parent-Report	Unknown/ Unclear	Video Game Internet Browsing	Non-Educational Consumptive	Fair	Good		German Version
		18b	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online Non-Educational Consumptive	Good	Good		
		19	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online Consumptive	Good	Good		

		20	Survey	Self-Report Parent-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online	Good	Unknown /Unclear	
Content-based Media Exposure Scale	C-ME	21	Survey	Self-Report	Cellphone/ Smartphone	Video Game Internet Browsing TV/ Video Streaming	Online Offline Non-Educational Consumptive	Good	Good	Measures a wider array of antisocial and risk behaviour content in popular media than common media exposure measurements.
Diagnostic Classification Test for Internet Addiction	DCT-IA	22	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing Video Game	Online	Good	Good	Can simultaneously measure general diagnostic information and detailed symptom criteria-level information for internet addiction based on the DSM-V. All items were transformed to dichotomous (Yes/No) responses.
Excessive Internet Use Scale	EIU	23	Survey	Self-Report Parent-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online Shared (Online Only) Non-Educational Consumptive	Good	Unknown /Unclear	Provides measurement of a broad range of potentially problematic internet use behaviours without asking about specific experiences or activities. Validated across Europe. Tested in 18 national surveys and in 15 languages. Only measures excessive internet use and does not take into account online activities.
Food, Health, and Choices Questionnaire	FHC-Q	24	Survey	Self-Report	Television Gaming Consoles	Video Game TV/ Video Streaming		Good	Poor	
Game Addiction Identification Test	GAIT	25	Survey	Self-Report Mother-Report Father-Report	Multi-Screen Composite (Unspecified)	Video Game	Online Offline Consumptive	Good	Good	First validated tool to measure gaming addiction symptoms in Swedish adolescents. High concordance between adolescent self-report and parent-report.

Game Addiction Scale	GAS	26	Survey	Self-Report	Unknown/ Unclear	Video Game	Consumptive		Unknown/ Unclear	Fair	Five-point Likert scale rather than a dichotomous tool, allowing greater sensitivity.	
		27	Survey	Self-Report	Unknown/ Unclear	Video Game	Online Offline Solitary Shared		Good	Good		Brazilian Version
		28	Survey	Self-Report	Unknown/ Unclear	Video Game			Unknown/ Unclear	Unknown /Unclear		
		29	Survey	Self-Report	Laptop Gaming Consoles	Video Game	Non-Educational		Good	Good		7 and 21-item adapted versions
Generalized Problematic Internet Use Scale 2	GPIU2	30	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Social Media	Sedentary Online Non-Educational Productive Consumptive	Facebook	Good	Good	Valid measure of generalized problematic internet use as determined by confirmatory factor analysis.	Portuguese version
		31	Survey	Self-Report	Cellphone/ Smartphone Laptop Desktop Tablet	Unknown/Unclear	Sedentary Online Solitary		Good	Good	Valid alternative measure of problematic internet use. Validated for use in the Portuguese cultural context.	Portuguese Version
		32a	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online Non-Educational		Good	Poor		
Healthy Computing Questionnaire for Children	HCQC	33	Survey	Self-Report	Laptop Desktop Tablet	Video Game Communication (Texting/Video Chatting) Internet Browsing General Computer Use	Online Offline Solitary Shared Educational		Good	Good		
Healthy Living for Kids Survey	HLKS	34	Survey	Self-Report	Laptop Television Gaming Consoles	Video Game TV/ Video Streaming	Sedentary Consumptive		Fair	Unknown /Unclear		
Implicit Association Test		34	Survey	Self-Report	Multi-Screen Composition (Unspecified)	Internet Browsing	Online Consumptive Productive		Poor	Good	Brief measure that is feasible to implement in a variety of settings.	
Internet Abusive Use Questionnaire	IAUQ	36	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online		Good	Good	Accessible to populations with average reading ability based on readability analyses.	
Internet Addiction Diagnostic Questionnaire	IADQ	37a	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online		Fair	Good		

Internet Addiction Scale	IAS	41	Survey	Self-Report	Unknown/ Unclear	Online Internet Gaming	Online Solitary Consumptive		Good	Good	Validated to assess internet addiction based on the diagnostic criteria in the DSM-V. Limited testing in clinical settings. Some factors consisted of only two question items.	Predominantly male sample population
Internet Addiction Test	IAT	38	Survey Automated Statistics	Self-Report	Unknown/ Unclear	Internet Browsing	Online Non-Educational Consumptive		Good	Good		
		37b	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online		Good	Good		Turkish Sample
		39b	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online		Poor	Poor		
		40a	Survey	Self-Report	Cellphone/ Smartphone	Communication (Texting/Video Chatting) Internet Browsing	Online Offline		Good	Good	Determined that the IAT can be divided into a three-factor model: (1) withdrawal and social problems, (2) time management and performance, and (3) reality substitute.	
		12b	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online		Unknown/ Unclear	Unknown /Unclear	IAT received the highest number of psychometric validations within different demographics, cultures, and languages.	
		42	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online		Good	Good	Easy to administer and interpret. Applicable to a wide range of measurement settings. No agreement in the field on the clinical cut off points for the IAT. Some have proposed cut off scores, but these have not been empirically validated.	
		43	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online	Facebook Tuenti	Good	Good	Some items of this questionnaire may be outdated due to technological and/or lifestyle changes.	Spanish Version Factors of technology use and lifestyle have been

									noted as being outdated
44	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online	Good	Good		Italian Version
32b	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online Non-Educational	Unknown/ Unclear	Unknown /Unclear		
45	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online	Good	Good		
46	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online	Good	Unknown /Unclear		Polish Version
9b	Survey	Self-Report	Unknown/ Unclear	General Internet Use	Sedentary Online Non-Educational	Good	Unknown /Unclear		
47	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Sedentary Online Non-Educational Consumptive	Good	Good		Turkish Version Sample population was exclusively university undergraduate students.
48	Survey	Self-Report	Unknown/ Unclear	Video Game Internet Gaming	Online Non-Educational Consumptive	Good	Good		Italian Version
49	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Unknown/Unclear	Online	Good	Good	Lack of consistent and tested cut-off scores. Items of the IAT do not appear to be developed using a rigorous psychometric process. Items are outdated in aspects of Internet use. No temporal dimension.	
50	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online Non-Educational Consumptive	Good	Good	Culturally adapted and validated a Greek version of the IAT. Three factors: psychological/emotional	Greek Version Sample population was

										conflict, time management, and neglected work.	exclusively medical school students.
		51	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online	Good	Good		
	IAT-A	52	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online	Good	Good	Could not reliably differentiate between addicts and non-addicts.	Adolescent version
	s-IAT-sex	53	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online Consumptive	Good	Good		Short version adapted to online sexual activities. Sample population is exclusively male.
Internet Addiction Test - Short Version	s-IAT	54	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Unknown/Unclear	Online	Fair	Good	Validated the s-IAT in a Vietnamese population. Stable two-factor structure.	
Internet Disorder Scale	IDS-15	55	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online Non-Educational	Good	Good	No cut-off scores to determine Internet addiction.	
Internet Gaming Disorder Questionnaire	IGDQ	17a	Survey	Self-Report	Unknown/ Unclear	Video Game Internet Browsing	Non-Educational Consumptive	Good	Fair		German Version
Internet Gaming Disorder Scale	IGDS	56c	Survey	Self-Report	Unknown/ Unclear	Video Game	Online Offline Consumptive	Good	Fair		
		57	Survey	Self-Report	Unknown/ Unclear	Video Game	Online Offline Consumptive	Unknown/ Unclear	Unknown /Unclear		
		58	Survey	Parent-Report	Multi-Screen Composite (Unspecified)	Video Game	Consumptive	Good	Fair	Moderate concordance between parent and adolescent ratings. Seems that both assessments are not interchangeable.	
Internet Gaming Disorder Scale - Short Form	IGDS-SF9	56a	Survey	Self-Report	Unknown/ Unclear	Video Game	Online Offline Consumptive	Fair	Good	Findings support the usage of this tool as an early diagnostic tool for Internet Gaming Disorder. No history of time spent playing online games was	Turkish Version

										measured. Not used to diagnose Internet Gaming Disorder.	
		7b	Survey	Self-Report	Unknown/ Unclear	Social Media	Online Shared (Online Only)		Good	Good	Based on the diagnostic criteria for Internet Gaming Disorder in the DSM-V. One-factor structure, invariant across gender.	Persian Version
		59	Survey	Self-Report	Unknown/ Unclear	Video Game	Online Consumptive	Online Gaming Platforms	Good	Good	Brief standardized and psychometrically sound measure for assessing Internet Gaming Disorder as outlined by the DSM-V. Clinical cut-offs need to be further tested to confirm their validity.	
		60	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Video Game	Online Consumptive	Online Gaming Platforms	Good	Fair	May underestimate or overestimate participant's Internet Gaming Disorder level.	
		61	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Video Game	Online Offline Non-Educational Consumptive		Good	Good	Determined that the Polish version of the IGDS9-SF adequately assesses Internet Gaming Disorder in Polish gamers. Suitable measure for assessing Internet Gaming Disorder. However, two items (7 & 8) were psychometrically problematic and presented with the poorest diagnostic accuracy.	Predominantly male sample population.
		62	Survey	Self-Report	Unknown/ Unclear	Video Game Internet Gaming	Sedentary Online Offline Non-Educational Consumptive		Good	Good	Valid and reliable in Portuguese adolescent population.	Portuguese Version
		63	Survey	Self-Report	Unknown/ Unclear	Video Game	Online Offline Consumptive	Online Gaming Platforms	Good	Good		
Internet Gaming Disorder Test 2	IGD-2	64	Survey	Self-Report	Multi-Screen Composition (Unspecified)	Video Game	Online Offline Educational Consumptive		Good	Unknown /Unclear		Arabic Version

Internet Gaming Disorder Test 10	IGDT-10	65a	Survey	Self-Report	Laptop Desktop Gaming Consoles	Video Game	Non-Educational Consumptive		Fair	Good	First study to provide empirical information about the measurement performance of the nine Internet Gaming Disorder criteria using IRT analysis.	
Internet Gaming Disorder Test 20	IGD-20	66	Survey	Self-Report	Cellphone/ Smartphone Laptop Gaming Consoles	Video Game	Online Offline Non-Educational		Good	Good	Applicable to all gamers and genres.	
		67	Survey	Self-Report	Cellphone/ Smartphone Laptop Gaming Consoles	Video Game	Online Offline		Good	Good		Spanish Version
Internet Gratification Scale for Adolescents		68	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online Solitary Shared		Good	Good		
Internet Motive Questionnaire for Adolescents	IMQ-A	69	Survey	Self-Report	Cellphone/ Smartphone Laptop	Video Game Social Media Communication (Texting/Video Chatting) TV/ Video Streaming Internet Browsing	Online	Facebook Skype ICQ	Unknown/ Unclear	Fair	Valid and reliable measure to assess adolescent motives for internet use. Motives assessed focus on affective change. Other motives should also be considered such as wanting to play games.	
Korean Scale for Internet Addiction	K-Scale	70	Survey	Self-Report	Unknown/ Unclear	General Internet Use	Sedentary Online Non-Educational Consumptive		Fair	Good	Validated the K-Scale for use beyond Korean populations. Validated for use in Japanese populations.	Korean version adapted for a Japanese sample population
Korean Smartphone Addiction Proneness Scale		71	Survey	Self-Report	Cellphone/ Smartphone	General Mobile Phone Use	Sedentary Online Offline		Good	Good		Author Created
Media and Technology Usage and Attitudes Scale	MTUAS	72b	Survey	Self-Report	Cellphone/ Smartphone	Video Game Social Media Communication (Texting/Video Chatting) TV/ Video Streaming Internet Browsing	Online Offline	Facebook	Unknown/ Unclear	Unknown /Unclear	15 subscales that break down smartphone use into discrete types.	
Mobile Phone Addiction Craving Scale		74a	Survey	Self-Report	Cellphone/ Smartphone	Unknown/Unclear			Good	Good	Helpful and fast evaluation tool of cell phone craving in the general population.	

											Did not assess anticipatory thoughts or previous time stages, as other scales have observed.	
Mobile Phone Dependence Questionnaire	MPDQ	40b	Survey	Self-Report	Cellphone/ Smartphone	Communication (Texting/Video Chatting) Internet Browsing	Online Offline		Unknown/ Unclear	Good	Assess three dimensions of mobile phone addiction: (1) compulsive text messaging, (2) compulsive making/receiving calls, and (3) distorted thinking about using mobile phones.	
		75	Survey	Self-Report	Cellphone/ Smartphone	Communication (Texting/Video Chatting)	Shared (Online Only)		Poor	Fair		
Mobile Phone Involvement Questionnaire		76b	Survey	Self-Report	Cellphone/ Smartphone				Fair	Unknown /Unclear		
Mobile Phone Problem Use Scale	MPPUS	77a	Survey Automated Statistics	Self-Report	Cellphone/ Smartphone	Social Media Communication (Texting/Video Chatting) TV/ Video Streaming Internet Browsing eBooks			Good	Poor		
		78a	Survey	Self-Report	Cellphone/ Smartphone	General Mobile Phone Use	Sedentary		Good	Good	Greater reliability than the original MPPUS1.	Spanish version adapted for British adolescents
		74b	Survey	Self-Report	Cellphone/ Smartphone	Unknown/Unclear			Unknown/ Unclear	Unknown /Unclear		
Mobile Phone Problem Use Scale - Short Form	MPPUS-10	79	Survey	Self-Report	Cellphone/ Smartphone	Communication (Texting/Video Chatting)		WhatsApp	Unknown/ Unclear	Fair	Study data is objective (collected from the Swiss network operators) minimizing recall bias.	
Online Cognition Scale	OCS	80	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing Other Online Activities	Online		Good	Fair	Valid measure of pathological internet use.	Polish version
		81	Survey	Self-Report	Unknown/ Unclear	Video Game	Online Non-Educational Consumptive		Good	Good		Modified version focused on online gaming.
Online Gaming Addiction Scale	OGAS	82	Survey	Self-Report	Unknown/ Unclear	Video Game Online Role-Playing Game	Online Non-Educational Consumptive		Good	Good	Differences in frequency of use based on day of the week was not assessed. Future research should measure frequency on weekdays and	

											weekends due to adolescent routines during the school week.	
Out-Of-School Nutrition and Physical Activity - Observational Practice Assessment Tool	OSNAP-OPAT	83	Ecological Momentary Assessment (EMA/ ESM) Survey	Passive Data Collection Teacher-Report	Multi-Screen Composite (Unspecified)	Unknown/Unclear	Educational		Poor	Fair		
Parents Role in Establishing healthy Physical Activity and Sedentary behaviour habits questionnaire	PREPS	84	Survey	Parent-Report	Multi-Screen Composite (Unspecified)	Video Game TV/ Video Streaming	Sedentary Educational		Good	Fair		
Persian Nomophobia Questionnaire	NMP-Q	76a	Survey	Self-Report	Cellphone/ Smartphone				Good	Good		
Problem Video Game Playing Scale	PVP	85	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Video Game	Online Offline Consumptive	Online Gaming Platforms	Poor	Fair	Reliability was low to moderate. This has been seen in other Spanish research. May indicate inadequacy in the wording of the Spanish version.	
		78b	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Video Game	Online Offline Consumptive		Fair	Fair		
Problematic and Risky Internet Use Screening Scale	PRIUSS	87	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online Consumptive		Good	Poor	Validated short screener for problematic internet use. Did not evaluate all possible combinations of items and thresholds to create the PRIUSS-3. Instead, a set of 3 scales was selected methodically and purposefully and then evaluated.	Predominantly female sample population.
Problematic Facebook Use Scale	PFUS	88	Survey	Self-Report	Unknown/ Unclear	Social Media	Sedentary Online Shared (Online Only) Consumptive	Facebook	Good	Fair	Five-factor structure that provides a good fit to the data. Tested across gender and multiple age groups. Invariance of the model supported across groups.	

											No cut offs for distinguishing problematic from non-problematic users.	
Problematic Internet Entertainment Use Scale for Adolescents	PIEUSA	78c	Survey	Self-Report	Unknown/ Unclear	Unknown/unclear	Online Non-Educational Consumptive		Good	Fair		
Problematic Internet Use Questionnaire	PIUQ	90	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online		Unknown/ Unclear	Good	Did not assess time spent online or the activities conducted online.	
Problematic Internet Use Questionnaire - Short Form	PIUQ-SF	91	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online		Poor	Good		
Problematic Internet Use Scale	PIUS	92	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online Solitary		Good	Good	Scale was developed by a multidisciplinary team of experts using previous research in a variety of fields.	
Problematic Mobile Phone Use Questionnaire Revised	PMPU-Q-R	93	Survey	Self-Report Clinician-Report	Cellphone/ Smartphone	Unknown/Unclear	Productive Consumptive	Facebook Twitter Reddit	Good	Good	Used focus groups to collect feedback on the measurement tool. Highlighted the need to consider sociocultural context in regard to problematic or antisocial smartphone use.	
Problematic Online Gaming Questionnaire	POGQ	65b	Survey	Self-Report	Laptop Desktop Gaming Consoles	Video Game	Non-Educational Consumptive		Good	Fair		
		94	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Video Game	Online Offline Shared (In-Person) Non-Educational Consumptive		Good	Good	Can be used regardless of whether participants are online or offline video gamers. However, this study did not consider offline gaming behaviour.	
Problematic Social Networking Services Use Scale	PSUS	95	Survey Structured Interviews	Self-Report	Unknown/ Unclear	Social Networking	Online Non-Educational Consumptive		Good	Good		
Psycho-Social Aspects of Facebook Use	PSAFU	96	Survey	Self-Report	Unknown/ Unclear	Social Media	Sedentary Online Solitary Shared Non-	Facebook	Good	Fair		Predominantly female sample population

							Educational Productive Consumptive					
Radio-Frequency Identification	RFID	97	Automated Statistics	Passive Data Collection	Television	TV/ Video Streaming	Sedentary Offline Consumptive	.	Poor	Unknown /Unclear	First tool to measure TV viewing time directly with a wireless connection. No risk of response bias.	
Risk of Addiction to Social Networks Scale	CrARS	98	Survey	Self-Report	Unknown/ Unclear	Social Media	Online		Good	Good		
Sedentary Behaviour Questionnaires		99	Survey Automated Statistics	Self-Report Passive Data Collection	Cellphone/ Smartphone Laptop Television	Video Game Communication (Texting/Video Chatting) TV/ Video Streaming	Sedentary Online Offline		Fair	Good		Not a formal questionnaire. Rather, a composition of multiple questionnaires.
Short Problematic Internet Use Test	SPIUT	18a	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online Non-Educational Consumptive		Good	Good	Although the measure was primarily designed to be inserted in the ESPAD questionnaire, it may be used as a stand-alone measure since it has been properly validated. Fails to measure time spent accessing adult entertainment or gambling resources. No clinical diagnosis standards for compulsive internet use.	Italian Version
Short Social Media Disorder Scale		100b	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Social Media	Sedentary Online Solitary Shared	Facebook YouTube Facebook Messenger WhatsApp Instagram Twitter	Good	Good	9-item scale presents similar validity to the 27-item version.	
Smartphone Addiction Inventory	SPAI	101	Survey	Self-Report	Cellphone/ Smartphone	Unknown/Unclear	Non-Educational Consumptive		Good	Good	Formatted a dichotomic version of the SPAI with internal consistency and a sensitivity comparable to the original version.	Portuguese version

		102	Survey	Self-Report	Cellphone/ Smartphone	Unknown/Unclear	Online Offline Non-Educational Consumptive		Good	Good	Strong concurrent validity: all correlations between the SPAI-I factors and the IAT total scores were significant and congruent. Four factors: compulsivity, daily life interference, craving, and sleep disorders.	Predominantly female sample population. Sample population was exclusively university undergraduate students.
		103	Survey	Self-Report	Cellphone/ Smartphone	General Mobile Phone Use	Non-Educational Consumptive		Good	Good	Adequately translated and adapted for use in Spain. Does not collect information on the type of mobile device used.	
		104	Survey	Self-Report	Cellphone/ Smartphone	Unknown/Unclear			Good	Good	Validated in a mainland Chinese sample.	Spanish Version
Smartphone Addiction Scale	SAS	105	Survey	Self-Report	Cellphone/ Smartphone	Unknown/Unclear	Online Offline Solitary Shared Productive Consumptive		Good	Good	Brief measure. Easy and accessible administration. Easily scored. The scale does not accurately capture the diagnostic criteria for Smartphone Addiction.	Turkish Version
		106a	Survey	Self-Report	Cellphone/ Smartphone	Unknown/Unclear	Sedentary		Good	Fair	Determined that the Arabic versions of the SAS and SAS-SV has strong psychometric properties. Some properties of the scale could not be assessed due to lack of comparable instruments and no clinical diagnosis for smartphone addiction.	Arabic Version Predominantly female sample population.
Smartphone Addiction Scale - Short Version	SAS-SV	72a	Survey	Self-Report	Cellphone/ Smartphone	Video Game Social Media Communication (Texting/Video Chatting) TV/ Video	Online Offline	Facebook	Good	Good		Predominantly female sample population

						Streaming Internet Browsing						
		107	Survey	Self-Report	Cellphone/ Smartphone	General Mobile Phone Use	Sedentary Non-Educational Consumptive		Good	Fair		Chinese Version
		106b	Survey	Self-Report	Cellphone/ Smartphone	Unknown/Unclear	Sedentary		Good	Good		Arabic Version
		108	Survey	Self-Report	Cellphone/ Smartphone	Unknown/Unclear	Online Offline	Facebook Twitter	Good	Unknown /Unclear	Scales had limited validity.	Sample population was exclusively college students.
Social Media Disorder Scale	SMD	109	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Social Media	Online Non-Educational Consumptive		Good	Good	Successfully adapted the Turkish version of the SMDS to measure internet and social media addiction in adolescents.	Turkish Version
		100a	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Social Media	Sedentary Online Solitary Shared	Facebook YouTube Facebook Messenger WhatsApp Instagram Twitter	Good	Good		
Social Networking Activity Intensity Scale	SNAIS	110	Survey	Self-Report	Multi-Screen Composition (Unspecified)	Social Media	Online		Good	Good	Two constructs emerged: (1) Social function, and (2) Entertainment	
Structured Clinical Interview for Internet Gaming Disorder	SCI-IGD	111	Survey Structured Interviews	Self-Report	Unknown/ Unclear	Video Game	Online Non-Educational Consumptive		Fair	Good	Psychometrically sound interview tool to assess IGD with greater precision than the brief screening questionnaire.	
Student Laptop Use and Musculoskeletal Posture	SLUMP	112	Survey	Self-Report	Laptop	Unknown/Unclear	Educational		Unknown/ Unclear	Unknown /Unclear	Many areas of measurement for laptop use including school, employment and recreation.	
		113	Survey	Self-Report	Laptop	Unknown/Unclear	Educational		Fair	Unknown /Unclear	First web-based instrument to evaluate biomechanical issues during laptop use. Wording of questions may have lacked clarity. Questions may not have been interpreted consistently.	More relevant to the measurement of biomechanical issues related to device usage. However,

											some items are applicable to digital media usage.
Study of Cognition, Adolescents and Mobile Phones	SCAMP	114	Survey	Self-Report	Cellphone/ Smartphone Laptop Gaming Consoles	Unknown/Unclear	Online Offline Non-Educational Unknown/Unclear		Unknown/ Unclear	Unknown /Unclear	First study to assess the validity of mobile phone data collected separately for weekdays and weekends. Results showed difference in agreement between these assessment periods.	
Technology-Related Psychological Consequences Questionnaire		115	Survey	Self-Report	Cellphone/ Smartphone Laptop	Communication (Texting/Video Chatting) Internet Browsing	Online Offline		Fair	Good	Revision of the instrument to measure aspects of technology-related psychological changes.	Revised Version
Third-Person Effect Questionnaire & Media Exposure List		73	Survey	Self-Report	Unknown/ Unclear	Unknown/Unclear			Unknown/ Unclear	Unknown /Unclear		
Unnamed		77b	Automated Statistics	Observation	Cellphone/ Smartphone	Social Media Communication (Texting/Video Chatting) TV/ Video Streaming Internet Browsing eBooks			Good	Good		Objective Measure of Smartphone Use
		39a	Survey	Self-Report	Unknown/ Unclear	Internet Browsing	Online		Fair	Fair	Used an ordinal scale for frequency of internet use. Author(s) propose the use of a quantitative measure. Differences in frequency of use based on day of the week was not assessed. Future research should measure frequency on weekdays and weekends due to adolescent routines during the school week.	Quantity-frequency measure of internet use
		116	Survey	Self-Report	Cellphone/ Smartphone	Communication (Texting/Video Chatting) Social Media Internet Browsing	Online Offline Solitary Shared Educational	Facebook Messenger WhatsApp Snapchat ooVoo Omegle	Unknown/ Unclear	Poor		School-based survey of mobile usage

								Chatroulette Skout 6rounds				
		117	Survey	Self-Report	Cellphone/ Smartphone Tablet	TV/ Video Streaming Online Apps and Games	Active Sedentary Productive Consumptive		Unknown/ Unclear	Unknown /Unclear	Collects general information. Would benefit from collecting more specific information such as types of activities, types of videos watched, etc.	
		118	Survey	Self-Report	Cellphone/ Smartphone Television	Video Game TV/ Video Streaming Internet Browsing			Good	Fair	Direct measure of violence exposure	
		119	Survey	Self-Report	Laptop Gaming Consoles	Video Game Communication (Texting/Video Chatting) Internet Browsing	Online Offline Educational Productive Consumptive		Fair	Poor		
		120	Survey	Self-Report	Unknown/ Unclear	Unknown/Unclear	Online Non-Educational Consumptive	Facebook	Good	Good		Screening scale of problematic Internet use.
		121	Survey	Self-Report	Unknown/ Unclear	Video Game TV/ Video Streaming General Computer Use	Sedentary Non-Educational		Fair	Fair	Indicators of screen time might not have captured all screen-based activities. Author(s) note that future researchers should ensure that the measure reflects screen-based devices used at that time due to the constantly changing technological environment.	Substudy of a comprehensive population survey titled "Brazilian Guide of Evaluation of Health-Related Physical Fitness and Life Habits"
		123a	Survey	Self-Report	Cellphone/ Smartphone	Communication (Texting/Video Chatting)		WhatsApp	Fair	Unknown /Unclear		
Videogame Addiction Scale for Children	VASC	122	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Video Game			Good	Good	Four-factor structure.	
XMobiSense		123b	Automated Statistics	Passive Data Collection	Cellphone/ Smartphone	Communication (Texting/Video Chatting)		WhatsApp	Unknown/ Unclear	Unknown /Unclear	Collects data on number and frequency of voice calls, in addition to laterality and hands-free usage.	

Young Diagnostic Questionnaire	YDQ	124	Survey	Self-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online Consumptive	Fair	Good	Unidimensional measure that offers less information that other assessments.
		125	Survey	Mother-Report Father-Report	Multi-Screen Composite (Unspecified)	Internet Browsing	Online	Fair	Good	
Young's Internet Addiction Test - Short Form	YIAT-SF	56b	Survey	Self-Report	Unknown/ Unclear	Video Game	Online Offline Consumptive	Fair	Good	
Youth Leisure-Time Sedentary Behaviour Questionnaire	YLSBQ	126	Survey	Self-Report	Laptop Television Gaming Consoles Multi-Screen Composite (Unspecified)	Video Game TV/ Video Streaming Internet Browsing	Sedentary Online Offline Educational Productive Consumptive	Good	Fair	Moderate to good test-retest reliability. Moderate validity, similar or better than previous versions adapted to this population.

Appendix C – Grey Literature Sources

Table 1. Study Characteristics – Grey Literature

Measurement Tool	Source #	Authors (Year)	Study Setting	Total Sample Size	Sample Age Group(s)	Race	SES - Index	Study Paradigm	Risk of Bias
EU Kids Online 2017	1	EU Kids Online (2017)	Unknown/Unclear	Unknown	School Age Adolescence Young Adults	Unknown	Not Specified	Survey (Local)	Moderate
January 2018 Core Trends Survey	2	Smith & Anderson (2018)	In-Home	2002	Young Adults	Unknown	Not Specified	National Survey	Low
2018 PEW Research Center's Parent Survey	3a	Jiang (2018)	In-Home, Online	1058	Adolescence	Unknown	Not Specified	National Survey	Low
2018 PEW Research Center's Teen Survey	3b	Jiang (2018)	In-Home, Online	743	Adolescence	Unknown	Not Specified	National Survey	Low
	4	Anderson & Jiang (2018)	In-Home, Online	1801	Adolescence	Unknown	Diverse SES – Author's Scale	National Survey	Low
2018 PEW Research Center's American Trends Panel	5	Smith, Toor, & van Kessel (2018)	In-Home	4594	Infancy Preschool Age School Age Young Adults	Unknown	Not Specified	National Survey	Low
Screens and Sleep Child Questionnaire	6a	Robb (2019)	In-Home, Online	1000	School Age Adolescence Young Adults	Unknown	Diverse SES – Author's Scale	National Survey	Low
Screens and Sleep Parent Questionnaire	6b	Robb (2019)	In-Home, Online	1000	School Age Adolescence Young Adults	64% White 17% Hispanic 12% Black	Diverse SES – Author's Scale	National Survey	Low
Social Media, Social Life Survey 2018	7	Rideout & Robb (2018)	Online	1141	Adolescence	54% White 23% Hispanic 14% Black	Diverse SES – Author's Scale	National Survey	Low
The Common Sense Census: Media Use by Kids Zero to Eight Questionnaire	8	Common Sense Media (2017)	Online	1454	Infancy Preschool Age School Age	56% White 23% Hispanic 11% Black	Diverse SES – Author's Scale	National Survey	Low
The Common Sense Census: Media Use by Tweens and Teens Questionnaire	9	Rideout & Robb (2019)	Online	1677	School Age Adolescence Young Adults	52% White 25% Hispanic 14% Black	High/Middle SES – Author's Scale	National Survey	Low
	10	Common Sense Media (2015)	Online	2658	School Age Adolescence Young Adults	54% White 23% Hispanic 13% Black	High/Middle SES – Author's Scale	National Survey	Low
The Common Sense Census: Plugged-in Parents of Tweens and Teens Questionnaire	11	Lauricella et al. (2016)	Online	1786	School Age Adolescence Young Adults	Unknown	Diverse SES – Author's Scale	National Survey	Low
The Digital Well-Being of Canadian Families Survey	12	Brisson-Boivin (2018)	Online	825	Infancy Preschool Age School Age Adolescence	Unknown	Diverse SES – Author's Scale	National Survey	Low

The New Normal: Parents, Teens, and Mobile Devices in Mexico Child Questionnaire	13a	Robb, Bay, & Vennegaard (2019)	Online	1226	Adolescence Young Adults	Unknown	Diverse SES – Common Index	National Survey	Low
The New Normal: Parents, Teens, and Mobile Devices in Mexico Parent Questionnaire	13b	Robb, Bay, & Vennegaard (2019)	Online	1226	Adolescence Young Adults	Unknown	Diverse SES – Common Index	National Survey	Low
Unnamed	14	Duggan (2015)	In-Home	1907	Young Adults	Unknown	Diverse SES – Author's Scale	National Survey	Low

Table 2. Digital Media Use Measurement Tool Characteristics – Grey Literature

Measurement Tool	Source #	Measure-ment Type	Informant	Digital Media Device	Media Type	Usage Characteristics	Specific Applications/ Websites	Reliability	Validity	Author Identified Tool Strengths/Limitations
EU Kids Online 2017	1	Survey	Self-Report	Cellphone/Smartphone Laptop Tablet Television Gaming Consoles Wearables Smart Toys	Video Game Social Media Communication (Texting/Video Chatting) TV/Video Streaming Internet Browsing	Active Sedentary Online Productive Consumptive	Facebook Snapchat Instagram Twitter	Unknown/ Unclear	Unknown / Unclear	Not reported
January 2018 Core Trends Survey	2	Survey	Self-Report	Cellphone/Smartphone Multi-Screen Composite (Unspecified)	Social Media TV/Video Streaming Internet Browsing	Online Offline	Facebook YouTube WhatsApp Snapchat Instagram Twitter LinkedIn Pinterest	Unknown/ Unclear	Unknown / Unclear	Not reported
2018 PEW Research Center's Parent Survey	3a	Survey	Parent-Report	Cellphone/Smartphone Multi-Screen Composite (Unspecified)	Video Game Social Media Communication (Texting/Video Chatting) Internet Browsing	Online Offline	Unknown/ Unclear	Unknown/ Unclear	Unknown / Unclear	Not reported
2018 PEW Research Center's Teen Survey	3b	Survey	Self-Report	Cellphone/Smartphone Multi-Screen Composite (Unspecified)	Video Game Social Media Communication (Texting/Video Chatting) Internet Browsing	Online Offline	Unknown/ Unclear	Unknown/ Unclear	Unknown / Unclear	Not reported
	4	Survey	Self-Report	Cellphone/Smartphone Laptop Gaming Console	Video Game Social Media	Online Offline Educational Productive Consumptive	Facebook YouTube Snapchat Instagram Twitter Tumblr Reddit	Unknown/ Unclear	Unknown / Unclear	Not reported
2018 PEW Research Center's American Trends Panel	5	Survey	Self-Report Parent-Report	Unknown/Unclear	TV/Video Streaming	Online Productive Consumptive	YouTube	Unknown/ Unclear	Unknown / Unclear	Not reported
Screens and Sleep Child Questionnaire	6a	Survey	Self-Report	Cellphone/Smartphone	Video Game Social Media	Online Offline Productive	Unknown/ Unclear	Unknown/ Unclear	Unknown / Unclear	Not reported

					Communication (Texting/Video Chatting) TV/Video Streaming Internet Browsing	Consumptive				
Screens and Sleep Parent Questionnaire	6b	Survey	Mother-Report Father-Report Parent-Report	Cellphone/Smartphone	Video Game Social Media Communication (Texting/Video Chatting) TV/Video Streaming Internet Browsing	Online Offline Productive Consumptive	Unknown/ Unclear	Unknown/ Unclear	Unknown / Unclear	Not reported
Social Media, Social Life Survey 2018	7	Survey	Self-Report	Cellphone/Smartphone Laptop Tablet	Social Media Communication (Texting/Video Chatting)	Online Offline	Facebook Snapchat Instagram Twitter Tumblr Reddit	Unknown/ Unclear	Unknown / Unclear	Not reported
The Common Sense Census: Media Use by Kids Zero to Eight Questionnaire	8	Survey	Parent-Report	Cellphone/Smartphone Laptop Tablet Television Gaming Consoles Digital Assistants DVD Player Virtual Reality Headset e-Readers Educational Gaming Devices Smart Toys	Video Game Social Media Communication (Texting/Video Chatting) TV/Video Streaming Internet Browsing eBooks Virtual/Augmented Reality Using Apps Take Photos/Videos	Online Offline Educational Productive Consumptive	YouTube Instagram Snapchat Netflix Amazon Prime Hulu Musical.ly Club Penguin Minecraft Animal Jam	Unknown/ Unclear	Unknown / Unclear	Not reported
The Common Sense Census: Media Use by Tweens and Teens Questionnaire	9	Survey	Self-Report	Cellphone/Smartphone Laptop Tablet Television Gaming Consoles Digital Assistants Wearables	Video Game Social Media Communication (Texting/Video Chatting) TV/Video Streaming Internet Browsing eBooks Virtual/Augmented Reality Music	Online Offline Educational Productive Consumptive	Unknown/ Unclear	Unknown/ Unclear	Unknown / Unclear	Not reported

				Virtual Reality Headset e-Readers	Writing Creating Art Shopping Coding Using Apps					
	10	Survey	Self-Report	Cellphone/Smartphone Laptop Tablet Television Gaming Consoles Portable Game Players Portable Music Players e-Readers	Video Game Social Media Communication (Texting/Video Chatting) TV/Video Streaming Internet Browsing eBooks Music Creating Art Using Apps	Online Offline Educational Productive Consumptive	Unknown/ Unclear	Unknown/ Unclear	Unknown / Unclear	Not reported
The Common Sense Census: Plugged-in Parents of Tweens and Teens Questionnaire	11	Survey	Parent-Report	Cellphone/Smartphone Laptop Tablet Television Gaming Consoles Portable Game Players e-Readers	Video Game Social Media Communication (Texting/Video Chatting) TV/Video Streaming Internet Browsing Music Working/School	Online Offline Educational Productive Consumptive	Unknown/ Unclear	Unknown/ Unclear	Unknown / Unclear	Not reported
The Digital Well-Being of Canadian Families Survey	12	Survey	Parent-Report	Cellphone/Smartphone Laptop Tablet Television Gaming Consoles Digital Assistants Virtual Reality Headset e-Readers Educational Gaming Devices Smart Toys	Video Game Social Media Communication (Texting/Video Chatting) TV/Video Streaming Internet Browsing eBooks	Online Offline Solitary Shared Educational Productive Consumptive	Unknown/ Unclear	Unknown/ Unclear	Unknown / Unclear	Not reported
The New Normal: Parents, Teens, and Mobile Devices in	13a	Survey	Self-Report	Unknown/Unclear	Video Game Social Media Communication (Texting/Video Chatting)	Online Offline Educational Productive Consumptive	Unknown/ Unclear	Unknown/ Unclear	Unknown / Unclear	Not reported

Mexico Child Questionnaire					TV/Video Streaming Internet Browsing					
The New Normal: Parents, Teens, and Mobile Devices in Mexico Parent Questionnaire	13b	Survey	Joint Parent-Report	Unknown/Unclear	Video Game Social Media Communication (Texting/Video Chatting) TV/Video Streaming Internet Browsing	Online Offline Educational Productive Consumptive	Unknown/ Unclear	Unknown/ Unclear	Unknown / Unclear	Not reported
Unnamed	14	Survey	Self-Report	Cellphone/Smartphone	Social Media Communication (Texting/Video Chatting)	Online Offline	Facebook WhatsApp Snapchat Instagram Twitter LinkedIn Pinterest Tumblr Reddit Digg Slashdot Kik Wickr iMessage	Unknown/ Unclear	Unknown / Unclear	Not reported

Appendix D – PRISMA Flow Diagram

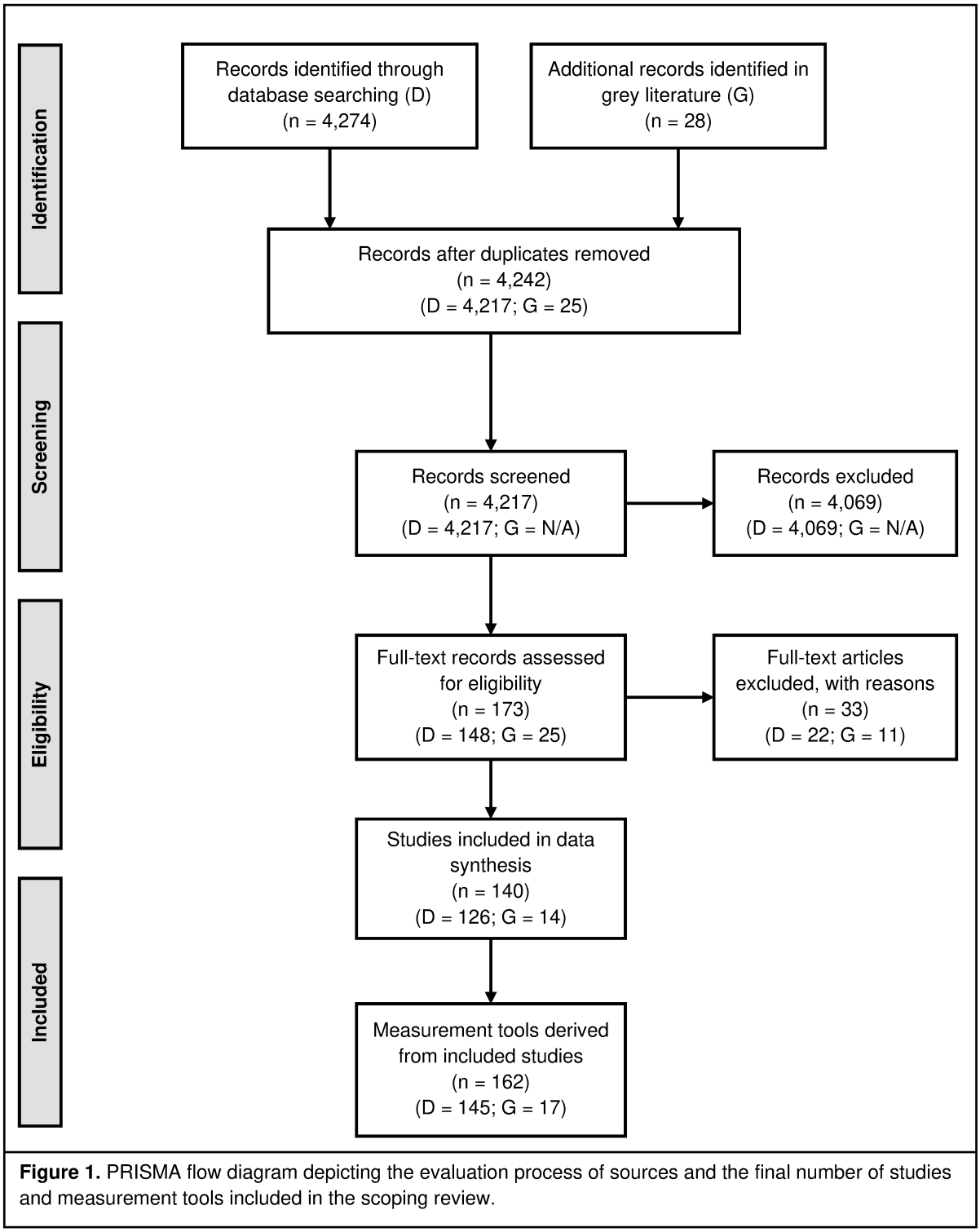

Figure 1. PRISMA flow diagram depicting the evaluation process of sources and the final number of studies and measurement tools included in the scoping review.

Appendix E: Scoping Review References

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