

Digital mental health interventions for young people aged 16-25: scoping review

Courtney Potts, Carmen Kealy, Jamie McNulty, Alba Madrid-Cagigal, Thomas Wilson, Maurice Mulvenna, Siobhan O'Neill, Gary Donohoe, Margaret Barry

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Abstract

Background: Digital mental health interventions for young people offer a promising avenue for promoting mental wellbeing and addressing mental health issues in this population.

Objective: This study aims to explore the range of digital mental health supports available for young people aged 16 - 25 years, with a particular focus on the types of digital tools, modalities, delivery format, target population, and study retention rates.

Methods: The scoping review was conducted in six databases (PubMed, Web of Science, Scopus, Medline, Cochrane Library and PsychInfo), and a total of 145 articles were included. The findings reveal a diverse landscape of studies globally, equally focusing on prevention and promotion of mental health as well as treatment of mental ill health, most commonly using cognitive behavioural therapy, with apps, web-based resources and websites being the most common digital tools.

Results: The results highlight the over emphasis on convenience sampling with participants mainly recruited from universities or colleges, and the lack of representation from marginalised groups, including LGBTQ+ youth, those from socioeconomically deprived backgrounds, and neurodivergent individuals. Moreover, the focus on anxiety and depression leaves other mental health conditions underrepresented. Retention rates were moderate, indicating room for improvement. There is a need for more research on preventative measures for those aged under 25 years when young people are at increased risk of mental health issues. This includes exploring different intervention approaches and modalities beyond cognitive behaviour therapy and ensuring inclusivity in study populations. Standardising intervention lengths and incorporating long-term follow-up data could provide valuable insights into the efficacy and effectiveness of digital interventions.

Conclusions: Future studies should aim for greater inclusivity, ensuring representation from marginalised groups to address the diverse mental health needs of young people effectively. By adopting these approaches, digital mental health interventions can become more accessible, engaging, and impactful for young people worldwide.

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Original Manuscript

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Abstract

Background: Digital mental health interventions for young people offer a promising avenue for promoting mental wellbeing and addressing mental health issues in this population.

Objective: This study aims to explore the range of digital mental health supports available for young people aged 16 - 25 years, with a particular focus on the types of digital tools, modalities, delivery format, target population, and study retention rates.

Methods: The scoping review was conducted in six databases (PubMed, Web of Science, Scopus, Medline, Cochrane Library and PsychInfo). Studies were included if they were published from 2019-2024 in English, reported on a population of young people aged between 16-25 and included validated pre and post mental health or wellbeing outcome measures. All types of digital interventions from promotion and prevention to treatment of mental health were included.

Results: After screening 13,306 articles, 145 articles were included in the final review.

The findings reveal a diverse landscape of studies, equally focusing on prevention and promotion of mental health as well as treatment of mental ill health, most commonly using cognitive behavioural therapy (used in 63% studies), with apps (38%), web-based resources (33%) and websites (14%) being the most common digital tools. The results highlight the over emphasis on convenience sampling (97% studies) with participants mainly recruited from universities or colleges, and the lack of representation from marginalised groups, including LGBTQ+ youth, those from socioeconomically deprived backgrounds, and neurodivergent individuals. Moreover, the focus on anxiety and depression leaves other mental health conditions underrepresented. Retention rates ranged from 16-100% and averaged 66% across all studies.

Conclusions: There is a need for more research on mental health promotion and prevention measures for those aged under 25 years when young people are at increased risk of mental health issues. This includes exploring different intervention approaches and modalities beyond cognitive behaviour therapy and ensuring inclusivity in study populations. Standardising intervention lengths and incorporating long-term follow-up data could provide valuable insights into the efficacy and effectiveness of digital interventions. Future studies should aim for greater inclusivity, ensuring representation from marginalised groups to address the diverse mental health needs of young people effectively. By adopting these approaches, digital mental health interventions can become more accessible, engaging, and impactful for young people worldwide.

Introduction

Background

In recent years, heightened attention has been directed towards mental health in young people, primarily prompted by the widespread prevalence and profound impact associated with various mental health conditions. The aggregate estimated prevalence of mental disorders reported for individuals aged 5 to 24 years indicates that more than 1 in 10 children and youths around the world, which equates to 293 million individuals, live with at least 1 diagnosable mental disorder [1]. The majority of mental disorders appear by age 14 but often remain undiagnosed and untreated in adulthood [2]. Prevalence rates obtained by a recent systematic review [2] were slightly higher than those obtained by studies published a few years ago. Over the entire life course, 25% of all years lived with disability attributable to mental disorders were recorded before age 25 years [1]. The gravity of this matter is striking when looking at various studies conducted around the world. The prevalence of mental disorders varies considerably in different countries for example 20% in North America, 12% in Europe and Asia, and 8% in Africa [3]. Differences in gender and age are also present as males are more likely to receive a diagnosis of ADHD compared to females, however females are more likely to be diagnosed with depression compared to males, and adolescents are more susceptible than children to affective disorders and behaviour disorders [4]. Worryingly, only 58% of young adults aged 18-25 with severe mental disorder are accessing treatment [5]. Anxiety, mood disorders such as depression and behavioural disorders are among the most prominent contributors [6]. Since 2020, state interventions in the context of the COVID-19 pandemic, such as enforced isolation or school closures, have most certainly increased the burden on young people's well-being and increased the likelihood of acquiring or worsening mental ill health [7]. Lower health-related quality of life and higher anxiety levels are now more common than before COVID-19, particularly among people with poor socioeconomic position, a migration background, or limited living space [8]. Despite these statistics, the global median of government health spending on mental health is less than 2%, and demand for face-to-face therapy continues to surpass capacity [9,10].

These trends highlight the urgent need for comprehensive strategies to address the complex interplay of mental health challenges using scalable solutions, as reflected in the health policies and strategy reports at both a European [11] and worldwide [12,13] level. The evolution of mental health services to incorporate digital interventions stands out as a promising avenue for effecting positive change on a global scale. One such scalable response has focused on the use of information and communications technology to boost capacity to support and improve young people's mental health [14].

Digital mental health interventions

Digital mental health interventions (DMHI) refer to the digital delivery of well-established psychological treatments by leveraging the use of technology including digital devices such as computers and smartphones [15]. DMHIs can include text, video, or audio-based technology and the most commonly used DMHI is internet-delivered cognitive behavioural therapy (iCBT) [16]. ICBT has demonstrated high usability and acceptability [17] as well as effectiveness at reducing symptoms of depression [18] and anxiety [19] among young people.

There are several barriers and facilitators for the use of DMHIs. From young people's perspective, perceived facilitators include anonymity, accessibility, and prompt feedback [20]. Greater reach to geographically isolated populations; flexible access; increased convenience; fewer visits to specialist clinics; greater privacy and anonymity; enhanced treatment fidelity; rapid scalability; and low-cost

delivery are also reported advantages of digital technologies [21].

Barriers include lack of personalization to individual needs, fear of misdiagnosis, and effectiveness of DHMIs [22]. Previous studies have reported low adherence and high dropouts among adolescents and young adults [23]. Human interaction has been highlighted as an important factor influencing engagement, as low adherence rates are reported in online interventions without therapeutic guidance [24,25]. Therefore, guided interventions usually report higher engagement rates than unguided interventions [26]. In this context, blended interventions refer to the integration of digital interventions with face-to-face mental health care [27,28], and have previously been found to be effective in improving students' mental health [29]. Nonetheless, previous reporting has highlighted heterogeneity across meta-analyses in the level of detail regarding the nature of the interventions, target populations, and type of support delivered, making it challenging to draw strong conclusions with regard to the circumstances under which human support is most effective [30].

Present review

Many reviews have been undertaken to evaluate the wide range of digital mental health supports accessible, but there are a dearth of up-to-date reviews, with many published in 2021 or before, thus failing to consider the change in the digital world since COVID-19 [19,31–34]. Most prior systematic and scoping reviews focus on specific topics only, such as technologies (e.g., apps only [35,36], specific aspects of mental health (e.g., depression and anxiety only [19,31,32,34,37], mental health promotion only [7]), study populations (e.g., university students for convenience [37,38]), and research techniques (e.g., randomised controlled trials (RCTs) alone [36]). Previous reviews [19,31,32,36–39] have primarily focused on determining effectiveness rather than on assessing implementation features, such as delivery formats, modalities, retention rates, of existing approaches across the spectrum of interventions from promotion, prevention to early intervention and treatment which is the focus of this review. Given previous studies often focused on one population type, this scoping review also explores at the inclusion of marginalised populations in the digital mental health support context. UNICEF defines “disadvantaged, vulnerable and/or marginalised adolescents as individuals aged 10–19, who are excluded from social, economic and/or educational opportunities enjoyed by other adolescents in their community due to numerous factors beyond their control” [40]. These factors include those operating at the social level (such as economic inequality, violence, stigma, racism, migration), family level (including neglect and abuse) and individual level (e.g., disability, ethnicity). Examples of disadvantaged, vulnerable and/or marginalised young people include immigrants, refugees, orphans, and those who belong to stigmatised indigenous, ethnic, or religious groups. They also include individuals who identify as belonging to ‘sexual minorities’ (e.g., gay, lesbian, bisexual, queer) or ‘gender minorities’ (e.g., transgender, gender diverse), which will be referred to as LGBTQ+ (lesbian, gay, bisexual, transgender, queer, and questioning) in the context of this review.

The purpose of this study is to report on a scoping review that was undertaken to investigate research findings on the range of digital mental health interventions and supports available for a broad range of young people aged 16 - 25 years, with a particular focus on the types of digital tools, modalities, delivery format, target population, and retention rates.

Specific research questions include the following:

- What are the characteristics of the studies that have been carried out involving digital mental health interventions for young people?
- What are the characteristics of digital mental health interventions offered to young people and to what degree are young people receiving human support in combination with digital?
- Who are the main target populations of digital mental health interventions for young people?
- What are the retention rates across studies involving digital mental health interventions with

young people?

Methods

A review protocol for this study has been registered with Open Science Framework (OSF) (https://osf.io/xvkas/?view_only=c64021ca70a44b4992e18495f2df4072). The search process was guided by the main stages outlined in the Arksey & O'Malley framework [41]. A search of the literature was initially conducted on 16 December 2022 and updated on 7 June 2024 in the following databases: PubMed, Web of Science, Scopus, Medline, Cochrane Library and PsychInfo. The search combined terms around four key concepts, including mental health, technology, young people, and interventions. The search strategy can be found in Table 1, and examples of search results can be found in Appendix 1. Reporting was guided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) (Appendix 2).

Table 1: Search terms used to identify studies across six key databases

Topic	Terms (combined together with AND statements)
Mental health	well-being OR wellbeing OR stress OR mental disorder OR mental illness OR mental health
Young people	youth* OR young* OR child* OR adolescen* OR student* OR teen*
Interventions	intervention OR promot* OR prevent* OR program* OR polic* OR implementation OR evaluation OR therap*
Technology	digital* OR mHealth OR eHealth OR web-based OR internet-based OR mobile phone OR text message OR text-based OR SMS OR app OR artificial intelligence OR tele* OR computeri*

Criteria

Articles published in English only were considered for inclusion. The full list of criteria can be found below. In the registered protocol on OSF, the original criteria stated that articles reporting on a study population of those aged between 12-25 would be included, however this was later refined to 16-25 years. Given there is no universal agreement on the definition of youth age group, populations between 16-25 years were selected to capture the out-of-school population of young people in the United Kingdom and Ireland as per education policies, and these ages fall within the range for young people reported by the World Health Organization (WHO) [42]. Grey literature was not included in the search strategy. Initially, the protocol on OSF stated that the search would include articles from the last 5 years, from 2017 to 2022. However, the search was updated in 2024, and thus included articles published from 2019 onwards. The search was restricted to studies published in the last five years (2019-2024) to ensure the review included the most relevant up to date literature, considering the rapid adoption and assessment of digital mental health technology throughout the sector in recent years, particularly during and COVID-19 pandemic [43]and beyond.

Inclusion criteria

- Population: Young people between ages of 16-25. If the sample population comprised people over the age of 25 or under the age of 16 then studies with a mean age greater than 16 and less than 25 were still included.
- Intervention: studies that focus on mental wellbeing, mental health, and mental health conditions, covering all interventions for mental health promotion and prevention, as well as treatment. The focus was on the digital intervention developed for or evaluated in the study. Studies with an element of human support were still included provided the main intervention component was a digital tool, and human support was an adjunct to the digital intervention offered to participants. All types of digital tools were covered, including but not limited to

websites, games and computer assisted programmes, chatbots and digital devices, virtual reality, mobile text messaging.

- Comparator: not applicable
- Outcome: validated pre and post mental health/ wellbeing outcome measures are included. Primary or secondary outcome(s) are mental health related.
- Type of publication: pilot or feasibility studies, randomised controlled trials, non-randomised controlled trials, other types of randomised trials, longitudinal studies, mixed methods. Studies published in the last 5 years (1 January 2019 until 7 June 2024)

Exclusion criteria:

- Population: studies that include young people on average under the age of 16, or over the age of 25
- Intervention: telemental health, telepsychiatry, teletherapy or telepsychology which include the digital delivery of one-on-one therapy or counselling services which are traditionally administered in person. In the context of this review, emphasis is placed on delivery or evaluation of a pre-defined digital mental health intervention programme (such as an iCBT course or other modality), and not on video, phone, or text-based individual counselling/therapy.
- Comparator: not applicable
- Outcome: studies that don't have mental health as a primary or secondary outcome
- Type of publication: qualitative studies, cross-sectional studies, student thesis

Study selection and data extraction

All records were imported to Covidence [44]. Duplicates automatically detected by Covidence were removed prior to screening. Title and abstract screening was conducted by four independent reviewers (CP, TW, CK and AMC). During the screening, articles were sorted by title in alphabetical order to compare the title, author name and abstract with consecutive articles to manually delete duplicates. Three reviewers (CP, TW and CK) completed the full text review. For both title and abstract screening and full text review, two independent reviewers screened all articles. Any conflicts were discussed and resolved between these two reviewers to reach consensus.

One author (CP) created the data extraction template which was later refined with two additional authors (TW and CK). The data extraction template included the main study characteristics (year, aim, study design, location), participant details for experimental and control groups (age, gender identity, inclusion of marginalised young people, number of participants, where participants were recruited, method of recruitment e.g. convenience sampling, participant type e.g. general population), intervention details (target area, delivery i.e. digital only or blended digital and human support, blended intervention details, type of digital tool, primary and secondary outcome measures and scales used, follow up and length, psychological modality used in intervention, duration, incentives, promotion/ prevention or intervention, intervention name and features) and retention (numbers of those who started and completed the study). One author (CP) extracted data from all of the articles included in the scoping review. A second author (CK) completed data extraction for a third of articles, and the first author (CP) completed a consensus template for these studies and discussed any discrepancies with the second author.

Data analysis

Data were analysed in R using R version 4.3.2.

RQ1: Characteristics of included studies

Summaries were computed for each study including the country of publication, research method and year of publication. Summary statistics were calculated for the length of studies in weeks, and the follow up length (if recorded) for the studies that included a follow up. In this paper, studies were labelled as including a follow up, if outcome measures were collected on any date after the post-study outcomes were obtained. If a study only recorded pre and post study measures, then they were marked as not recording follow up data. Summary statistics were included for participant numbers in both the experimental and control groups, where reported. Text analysis, using the tm package[45] was used to explore the most common primary and secondary outcomes, and for the scales used to measure the most frequent outcomes. Summaries were calculated for the studies that included incentives versus those that did not and for the types of incentives used.

RQ2: Characteristics of interventions

To explore the characteristics of interventions, the interventions with similar or the same names were checked across studies to identify which studies reported on different aspects of the same digital intervention. A new dataset was created containing the target area(s) for the intervention, type of digital tool, features of each intervention, if the intervention was digital only or had an element of human support (blended intervention) and the type of human support (relevant for blended interventions only), and the features of each intervention, with duplicate information removed. Summaries were computed for each of those categories. For the intervention features, a list of features was derived based on the intervention descriptions in each paper. For example, many of the papers mentioned the intervention specifically included psychoeducation content, or explaining information on mental health and how to manage symptoms, which was also recorded as psychoeducation or education. Some studies referred back to a previous paper which detailed intervention features. Blended interventions were classes as those that had any degree of human support alongside the digital intervention and were categorised according to the author description in the papers. A donut plot was produced for the delivery of interventions (digital only or blended) across the different types of digital tools using the webr package[46]. Given the high degree of overlap within the blended interventions, a Venn diagram was used to illustrate the peer, clinician and research team support offered, and an upset plot (using UpSet R package[47] and ComplexUpset[48]) was used for data visualisations of the type of blended support offered.

RQ3: Target populations

Summaries were calculated for the target populations across studies. The three primary study populations included the *general population*, defined as recruitment of young people in a general sense with no specific mental health recruitment criteria; *experiencing mental ill health symptoms*, most commonly mild-moderate symptoms self-reported by the participants themselves, but in some cases based on mental health scales which were administered to determine if participants were experiencing problems with their mental health; *mental health diagnosis*, which was defined as moderate-severe symptoms either by participants self-reporting that they had a mental health diagnosis, or through researcher administered mental health scales where participants would receive a clinically significant score indicative of mental health diagnosis (e.g. a score of 10 or higher on the Patient Health Questionnaire-9 PHQ-9 indicating moderate to severe depression). Summaries were reported for the sampling approach used, and recruitment source for participants were visualised using the UpSet R package[47] and ComplexUpset[48]). For age of participant across experimental and control groups, the mean of means was calculated from the mean ages reported across all studies that reported this information. To explore gender inclusivity, the proportion of gender in each study was explored for those identifying as male, female and LGBTQ+. Combined boxplots and violin plots were used to visualise the gender identity breakdown using the ggplot2 package[49]. An upset

plot was used to visualise the representation of marginalised groups in study populations across papers using the UpSet R package[47] and ComplexUpset[48]. Across the three main participant types, a donut plot (webr package[46]) was used to illustrate the breakdown of digital only versus blended human and digital support across the three main participant types, Venn diagrams were produced to visualise the different psychological treatment modalities and a grouped bar chart was used to display the proportions of the main intervention features.

RQ4: Retention rates

There was no way to report on actual engagement with the content within interventions, as studies report this differently or not at all in most cases. Thus, retention rates were calculated as the number of people that started the study and were allocated to receive the digital intervention, divided by the number of people that completed the studies, converted to a percentage out of 100. For studies that included a follow up, the number of people that completed the study was taken as the number that completed the final follow up assessment. For the studies that did not include a follow up, the number of people that completed the study was taken as the number of people that completed the post-study outcomes. Summary statistics were calculated for the retention rates overall, and for different categories including study types, delivery methods, type of digital tools, study population and incentives. Summaries of studies with high retention rates ($\geq 90\%$) were also calculated in terms of the number of participants recruited, length of studies, follow up measures and when they were recorded, and whether incentives were used.

Results

A total of 36,591 records were identified across the six databases that were searched; however, 23,285 articles were removed as they were identified as duplicates (Figure 1). Through abstract and full text screening, 12,893 articles total were removed and the reasons for removal are outlined in Figure 1. A total of 145 articles were included in the final review (Figure 1).

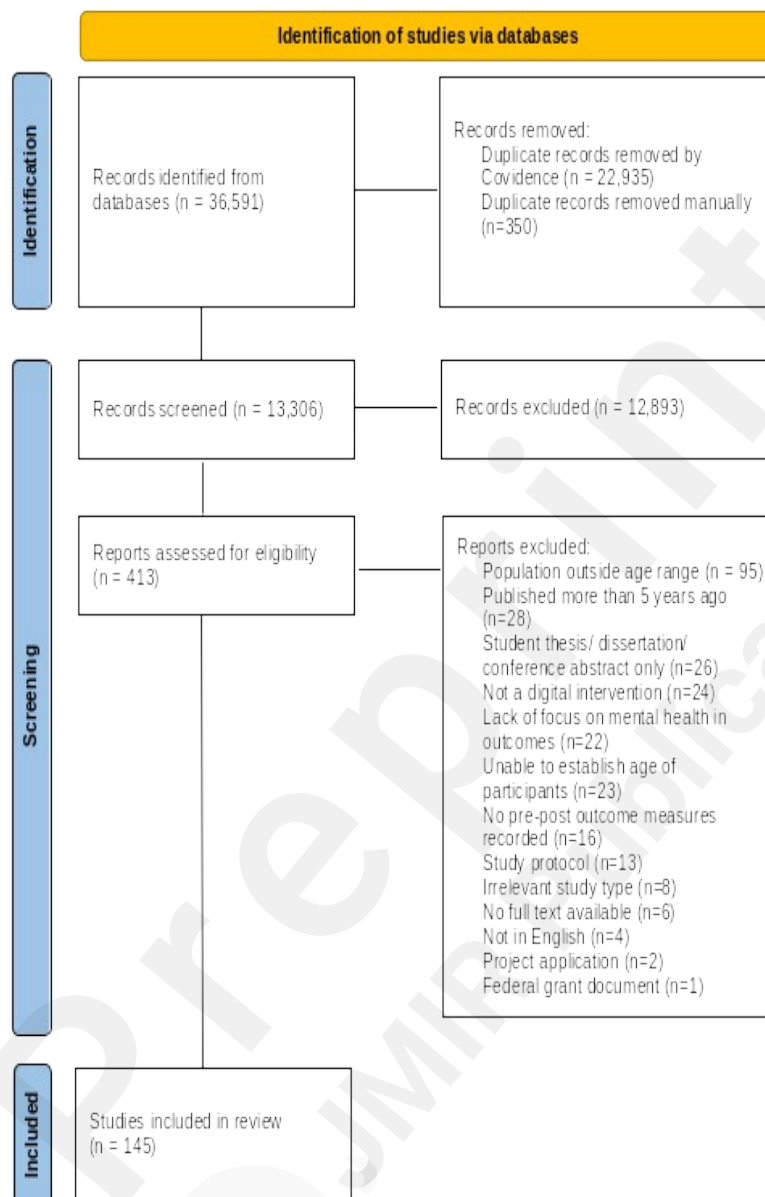


Figure 1: PRISMA diagram

RQ1: Characteristics of included studies

Table 1: Study characteristics

Characteristic		n (%)	References
Country of publication			
	United States of America	43 (30)	[50–91]
	Australia	16 (11)	[92–107]
	United Kingdom	14 (10)	[108–121]
	China	11 (8)	[122–132]
	Canada	11 (8)	[133–142]
	Netherlands	7 (5)	[143–149]
	New Zealand	6 (4)	[150–155]
	Germany	4 (3)	[156–159]
	Finland	3 (2)	[160–162]
	Sweden	3 (2)	[18,163,164]
	Austria	2 (1)	[165,166]
	India	2 (1)	[167,168]
	Iran	2 (1)	[29,169]
	Italy	2 (1)	[170,171]
	Singapore	2 (1)	[172,173]
	Switzerland	2 (1)	[174,175]
	Brazil	1 (<1)	[176]
	Colombia	1 (<1)	[177]
	Czech Republic	1 (<1)	[178]
	Denmark	1 (<1)	[179]
	France	1 (<1)	[180]
	Indonesia	1 (<1)	[181]
	Ireland	1 (<1)	[182]
	Japan	1 (<1)	[183]
	Latvia	1 (<1)	[184]
	Lithuania	1 (<1)	[185]
	Malaysia	1 (<1)	[186]
	Poland	1 (<1)	[187]
	Portugal	1 (<1)	[188]
	South Korea	1 (<1)	[189]
	Tunisia	1 (<1)	[190]
	USA and Canada	1 (<1)	[191]
Research method			
	Randomised controlled trial	81 (56)	[18,50,51,53,54,56,60–62,65,66,69,73,75,79–85,87,90–93,99,102–105,107,108,115,116,119,121–125,127,129–

			132,134,136–139,142,143,147,151,153,155–157,159,162,164–167,169,170,172,174–177,179,182,183,185,187,189–192]
	Pilot trial	19 (13)	[59,63,67,71,76–78,88,94–96,98,101,106,111,113,146,154,188]
	Feasibility study	16 (11)	[55,57,70,89,100,109,112,117,120,128,150,163,173,178,181,184]
	Longitudinal study	5 (3)	[74,97,110,148,149]
	Open trial	3 (2)	[52,72,152]
	Quasi-experimental study	3 (2)	[29,161,186]
	Pre-post	2 (1)	[160,168]
	Other study types ^a	16 (11)	[3,58,64,68,86,114,118,126,133,140,141,144,145,158,171,180]
Year of publication			
	2019	15 (10)	[18,29,69,70,72,104,107,116,117,130,138,153,166,169,191]
	2020	27 (19)	[61,65,67,68,74–76,94–98,106,109,115,118–120,137,151,160,162,164,177,178,182,189]
	2021	23 (16)	[63,64,71,77–80,105,110,111,121,132,139,140,146,152,154,159,161,167,168,170,171]
	2022	29 (20)	[60,66,81–83,85,86,99,112,113,122,124,128,129,131,136,141,142,147,149,155,163,172,173,180,184,185,190,192]
	2023	33 (23)	[50,52,55,56,58,59,73,84,87–89,91–93,100,102,103,108,114,123,127,135,144,145,148,150,156,158,175,176,179,187,188]
	2024 ^b	18 (12)	[51,53,54,57,62,90,101,125,126,133,134,157,165,174,181,183,186]

^a other study types included: 3-staged participatory, co-design approach; evaluation; feasibility and acceptability; implementation-effectiveness; micro-randomised; mixed-methods; non-randomised

controlled trial; proof-of-concept; quantitative; randomised trial; randomised dismantling trial; randomised factorial trial; repeated measures within-subjects study; secondary data analysis; type 1 effectiveness-implementation randomised controlled trial; uncontrolled trial

^b Until 7 June 2024

Table 1 provides an overview of the country of origin, the research methodology and year of publication for each study. Of the total 145 studies, 87 (54%) reported on digital tools for primary prevention and/or mental health promotion, and the remaining 64 (46%) were digital tools for early intervention or treatment of mental ill health symptoms.

The studies ranged from one-off single sessions with a digital tool up to 26 weeks (6 months) (Figure 2). The most common length of studies was 4 weeks (Figure 2), and the mean study length was 6 weeks. Other prescribed intervention durations included: 1-2 weeks, 1-9 weeks, 3-6 weeks, 3-12 weeks, and two studies did not detail study length. Under half of the studies ($n=63$, 43%) recorded a follow-up with participants outside of the conventional pre-post study data. A total of 48 of these 63 studies recorded only one follow-up anywhere from 2-weeks after the intervention period up to 52-weeks, while the most common follow up period was 12 weeks, and the mean follow up time for these studies was 19 weeks. Ten studies followed up with participants at two time points (e.g. after 4 weeks and after 12 weeks), and two studies followed up with participants at three time points (e.g. at 8 weeks, 12 weeks and 24 weeks).

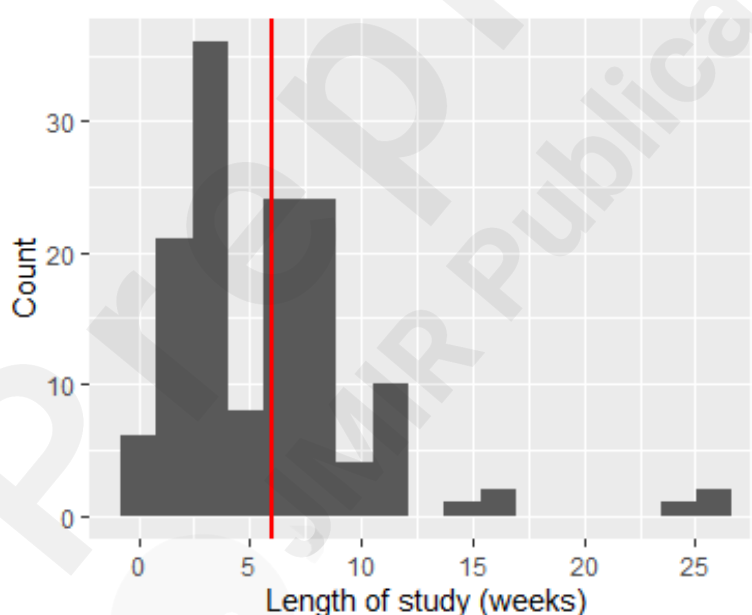


Figure 2: Intervention duration across studies. Red line = mean study duration.

Participant numbers

The number of participants recruited to the experimental groups varied greatly across all studies, ranging from 8 to 2,222 (mean=167, SD=303). A total of 88 studies (61%) included at least one control group, and the number of participants recruited in these cohorts ranged from 12 to 2,355 (mean=148, SD=281).

Outcome measures

The most common primary outcomes that were assessed across studies were depression ($n=72$, 50%), anxiety ($n=62$, 43%), stress ($n=38$, 26%), wellbeing ($n=25$, 17%) and mindfulness ($n=11$, 8%). The top secondary outcomes included anxiety ($n=30$, 21%), depression ($n=22$, 15%), wellbeing

(n=12, 8%), self-efficacy (n=10, 7%) and attributes of mindfulness (n=11, 6%). The most frequently used validated mental health scales across studies to assess outcomes are shown in table 2.

Table 2: Most frequently used mental health scales across studies

Scale	Short name or scale variations used	Studies, n (%)
Patient Health Questionnaire	PHQ-9, PHQ-8, PHQ-4, PHQ-2	35 (24%)
Generalised Anxiety Disorder	GAD-7, GAD-2 and GAD-Q	24 (15%)
Depression Anxiety Stress Scales	DASS-21	17 (12%)
Perceived Stress Scale	PSS-10, PSS-4	16 (11%)
Warwick Edinburgh Mental Wellbeing Scale	WEMWBS, SWEMWBS	10 (7%)

Incentives

Over half of the studies (n=80, 55%) reimbursed participants for taking part in the study or gave some type of incentive for taking part. Reimbursement typically included a monetary incentive such as all participants receiving a voucher or money for completing the baseline/ post intervention/ follow up measures (n=47, 32%), some form of course credit for those who were studying (n=11, 8%), either a voucher or money/ gift card and/ or course credit (n=11, 8%), entry into a prize draw (n=4, 3%), a voucher or money and entry into a prize draw (n=4, 3%) or a phone and service/ data plan for the intervention duration (n=1, <1%). Other incentives included annual app subscriptions (n=1, <1%), participants given a service and data plan and phone for intervention duration (n=1, <1%), and a gift card for each questionnaire completed along with free app membership (n=1, <1%).

RQ2: Characteristics of interventions

Ten interventions were used across more than one study, including *Calm* [69,118], *EMCompass* [146,156], *Grow It!* [148,149], *imi* [73,83], *LifeBuoy* [92,99], *Mindfulness Virtual Community* [137,139], *Spark* [53,91], *Step-by-Step* [126,128], *Tita* [160,162], and *Whitu* [154,155]. Thus, this section of results reports on all unique interventions (n=135 total) and duplicate interventions where the exact same intervention was used across studies have been taken out.

Target area

Most interventions were targeted at general mental wellbeing, depression, anxiety, or stress, or combinations of these four areas relating mental health (Table 3).

Table 3: Target area for digital mental health interventions across all studies (N=135)

Target area ¹	n (%)
General mental wellbeing	52 (36)
Depression	19 (13)
Anxiety, depression	8 (6)
Stress	6 (4)
Distress	5 (3)
Anxiety	4 (3)
LGBTQ+ specific	3 (2)
Help-seeking	3 (2)
Loneliness	3 (2)
Anxiety, depression, general wellbeing	2 (1)
Anxiety, depression, stress	2 (1)

Anxiety, depression, suicidal ideation	2 (1)
Anxiety, stress	2 (1)
Resilience	2 (1)

¹Other target areas not listed in the table: anxiety, depression, low mood; anxiety, depression, repeated negative thinking; anxiety, depression, social anxiety, insomnia; childhood adversity and low self-esteem;

distress and adjustment; general wellbeing; general wellbeing, substance use; mental health diagnostic and severity spectrum and stages of treatment; mental health literacy; parents have a mental illness and/or substance use disorder; perfectionism; psychological flexibility; PTSD and CPTSD; reward responsiveness; self-efficacy; self harm; social anxiety; social connection; stress, general wellbeing; suicidal ideation; suicidal ideation and insomnia; suicidal ideation, low mood and self-harm; suicide prevention

Intervention types

The most common type of digital tool was apps (n=51, 38%), followed by web-based resources (n=45, 33%), websites (n=19, 14%), chatbots (n=6, 4%), virtual reality (n=2, 1%) an app with a game (n=2, 1%), and a an app with a chatbot (n=2, 1%). Other types included an app with a game, an app with text messaging; an app with virtual reality; an app with a wearable; emails; game; metaverse; text messaging; a website with social media; a website with text messaging and wearable.

Intervention features

Table 4 reports on the features of the digital interventions, used across the 135 unique digital interventions, which includes studies that used different variations of the same intervention suites including *IntelliCare (Pocket Helper, Purple Chill and Slumber Time or IntelliCare for College Students)* [70,76] *MOST+ and MoST-MH* [80,95], and *Silvercloud (Space for Resilience/ Space from COVID-19 or Space from Depression)*.

Table 4: Intervention features across all 135 unique digital interventions

Feature	n (%)
Psychoeducation or education	97 (72)
Mindfulness or breathing or relaxation exercises	70 (52)
Videos	58 (43)
Mood logging or check ins	53 (39)
Audio	37 (27)
Photos	32 (24)
Messaging system or texts	29 (21)
Writing exercises or diaries or journalling	26 (19)
Goal setting	26 (19)
Interactive tasks	25 (19)
Push notifications or reminders	25 (19)
Signposting to external resources	24 (18)
Gamification or rewards	21 (16)
Self-help information or monitoring	19 (14)
Homework exercises	18 (13)
Personalisation or customisation	18 (13)
Email prompts	16 (12)
Coping strategies	14 (10)
Personal or peer stories or testimonials	14 (10)

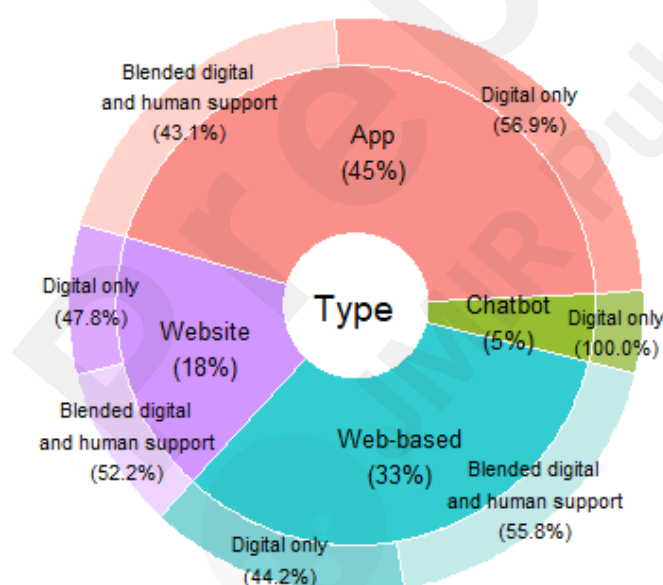
EMA or ESM	12 (9)
Gratitude	11 (8)
Feedback to users	11 (8)
Peer forum or interactions	10 (7)
Self-help plan or relapse plan	9 (7)
Quiz	8 (6)
Video conferencing	6 (4)
VR	4 (3)
General health tracking	2 (1)
Dot probe	2 (1)
Keyword triggers	2 (1)

Intervention approach

Just over half of the studies utilised a digital only approach (n=70, 52%) and the rest of the studies (n=65, 48%) used a blended approach, where participants had some degree of human support which was either peer, clinical or research team led alongside a digital intervention (Figure 3).

Figure 3: Delivery of intervention across different types of digital tool (n=135 studies included)

Of the 65 studies that utilised some degree of human support, the blended approach between digital and human support varied between studies and overlapped in many cases (Figure 4). These approaches included: some sessions delivered in person or via telehealth communication (n=18, 27%); participants were able to speak to a professional or someone from the research team if needed



(n=16, 25%); weekly check-ins with participants (n=12, 18%); participants mental health was monitored, and they were directed to professional help if needed (n=11, 17%); participants had peer group support (n=11, 17%); participants already attending a mental health service and the digital tool was one part of the intervention (n=9, 14%); digital tool delivered in person (n=3, 5%); group sessions were delivered as part of the intervention (n=2, 3%); coaching from a professional/ member of the research team (n=2, 3%); and participants received the digital intervention whilst on a waiting list for face-to-face services (n=2, 3%).

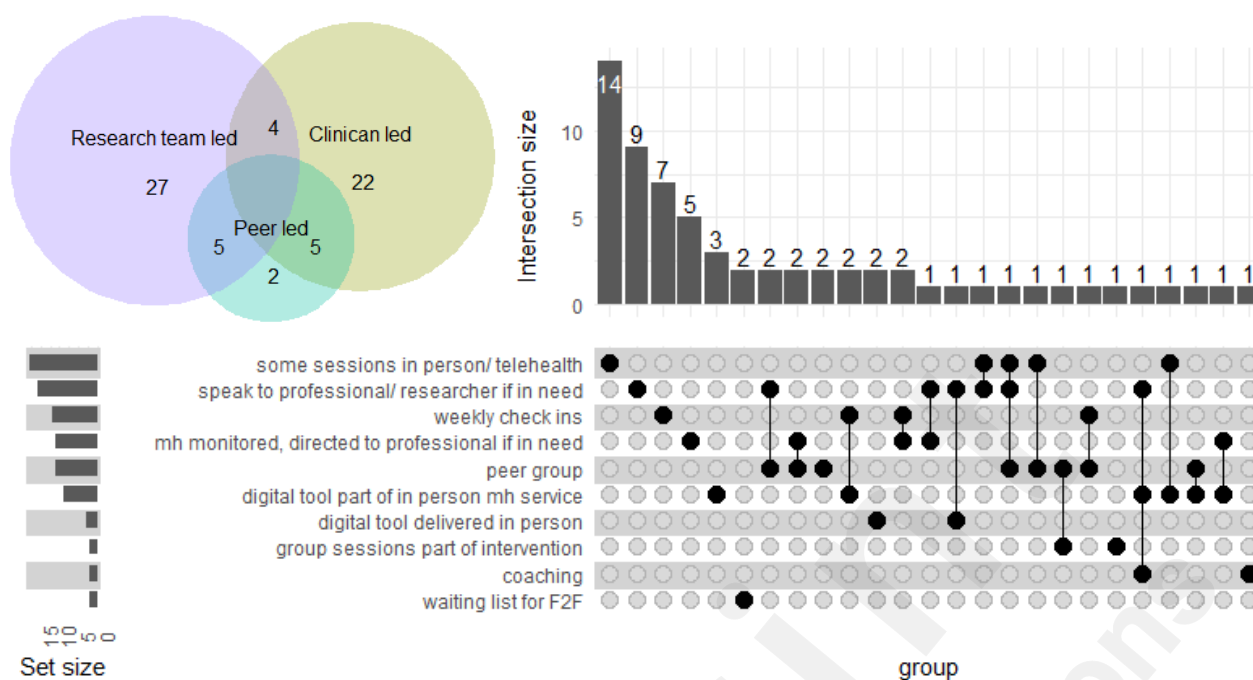


Figure 4: Type of blended interventions used across studies (n=65). Venn diagram showing overlap between peer, clinician and research team support. Upset plot showing degree of overlap between specific types of blended support (mh= mental health, F2F=face-to-face).

RQ3: Target populations

Recruited populations

Less than half of the studies recruited participants from the general population with no specific focus on recruiting young people experiencing mental ill health (n=63, 43%), around a third recruited participants experiencing mental ill health symptoms (n=38, 30%), and 18% (n=27) studies included participants with a mental health diagnosis or who met clinical/ diagnostic criteria for a mental health diagnosis. A small number of studies (n=6, 4%) included a mix of participants who weren't experiencing mental health symptoms alongside those with a mental health diagnosis, 5 studies (3%) recruited participants with a specific physical health diagnosis, 4 studies (3%) recruited only an LGBTQ+ population, and 2 studies (1%) recruited only a homeless population. Further details on the mental health conditions for those who had a mental health diagnosis or met diagnostic criteria can be found in table 5.

Table 5: Participant information for studies that recruited individuals with a mental health diagnosis or met diagnostic criteria (n=27 studies)

Mental health condition	Details and number of studies	Sample sizes (n) of those who started study mean (SD)	Percentage (%) of those who completed study mean (SD)	References
Depression (n=7)		43 (23)	81 (19)	
	Depression (n=3), major depressive disorder (n=3), young people with or at elevated risk of depression (n=1)			[55,85,111,120,124,128,133]
Anxiety (n=5)		105 (94)	64 (24)	
	Generalised anxiety disorder (n=3), anxiety (n=1), social anxiety (n=1)			[50,66,130,142,167]
Depression and/or anxiety (n=5)		49 (43)	78 (22)	
	Anxiety and/or			[67,93,117,119,131]

	depression (n=4), clinical levels of depression or anxiety on Patient Health Questionnaire-8 or Generalised Anxiety Disorder-7 (n=1)			
Depression and/or anxiety with other co-morbidities (n=5)		28 (14)	82 (15)	
	Major depressive disorder, reactive attachment disorder, panic disorder, attention-deficit/hyperactivity disorder, intermittent explosive disorder, borderline personality disorder, and parent-child relational problem (n=1)			[146]
	Depression or distress (n=1)			[98]
	Depression/ major depressive episode, and co-morbidities with generalized anxiety disorder, social anxiety disorder, panic disorder and agoraphobia (n=1)			[18]
	Anxiety, depression, social anxiety, or insomnia (n=1)			[74]
	Depression, bipolar disorder, anxiety disorder and psychosis (n=1)			[156]
Other (n=5)		42 (26)	75 (19)	[106]
	Psychotic disorder, Schizophrenia, Schizoaffective disorder,			[185]

	Schizophreniform disorder (n=1)			
	Post-traumatic stress disorder and complex post-traumatic stress disorder (n=1)			
	Social phobia (n=1)			[94]
	Psychosis and borderline personality disorder (n=1)			[101]
	Specific details not reported, inclusion criteria stated that only participants with a current mental health diagnosis documented in their electronic medical record or received mental health services within 3 months per self-, parent-, or clinician-report could participate (n=1)			[80]

Sampling and recruitment strategies

Almost all of the studies ($n=140$, 97%) utilised a convenience sampling approach, whilst the remaining studies used a convenience sampling approach with snowballing ($n=1$, <1%), cluster randomisation of schools ($n=1$, <1%), geographically representative sampling ($n=1$, <1%), sampling representative of the depressive population ($n=1$, <1%) and random sampling ($n=1$, <1%). Participants were predominately from educational institutions, as universities were the most popular source for recruitment ($n=87$, 60%) whilst online/ social media ($n=60$, 41%) was the second most popular (Figure 5).

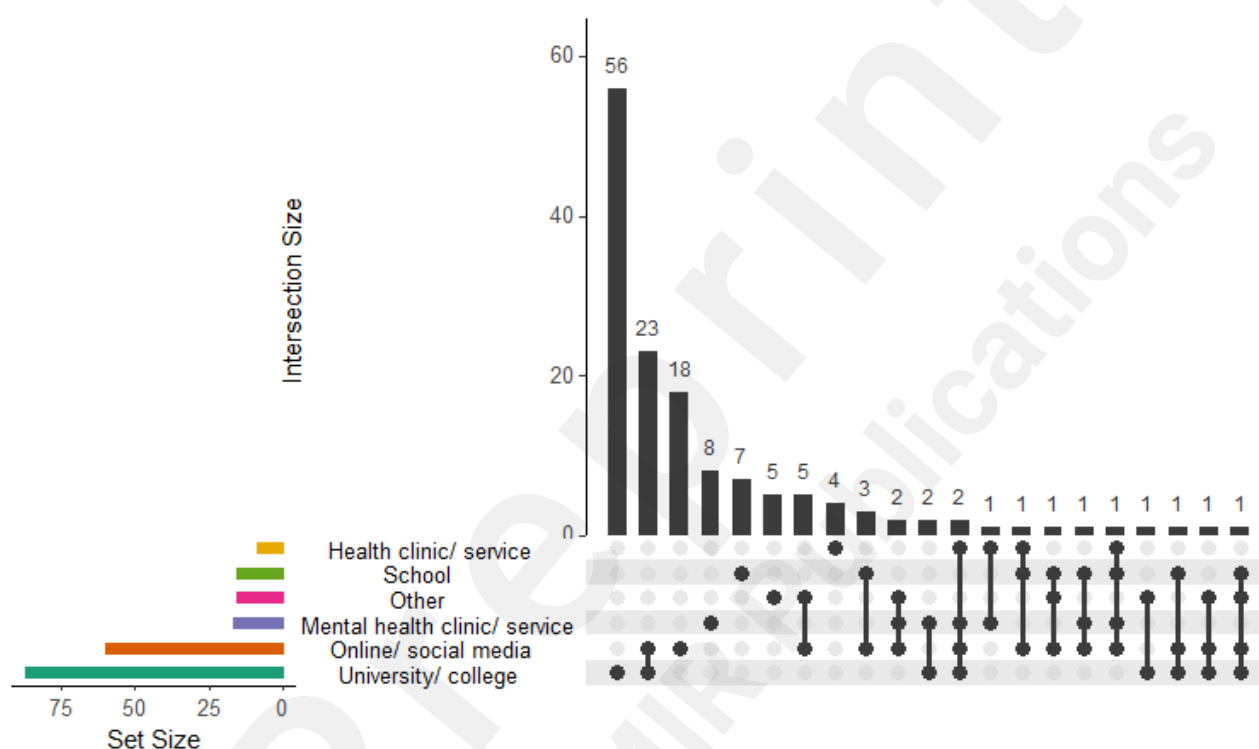


Figure 5: Participant recruitment sources across all studies

Age and gender identity

The overall mean age of the experimental group(s) from all of the included studies that reported mean age ($n=133$) was 20.8. A total of 12 studies did not include specific ages of their population, only the age range of the experimental group(s) which fell within the ages of 16-25. The overall mean age of the control group from all of the included studies that included a control group and reported mean age ($n=82$) was also 20.8, while the remainder ($n=6$) only reported age range.

Females were largely overrepresented within the study groups, making up 71% study populations on average across 142 studies, while males on average made up 28% populations across 127 studies (Figure 6). Three studies included an entirely female population[68,164,169]. Gender was not reported equally across studies, as a total of 15 studies did not include and/ or report the gender breakdown of male participants, and 3 did not include and/ or report the gender breakdown of female participants. Only 53 (37%) studies included individuals identified as LGBTQ+ (Figure 6), with the

highest representation from transgender and non-binary individuals. For these 57 studies, inclusion of LGBTQ+ groups ranged from 1%-100% study population (mean=13%, SD=22%). As mentioned in Table 3, three interventions were specifically targeted at improving the mental health of those who identified as LGBTQ+.

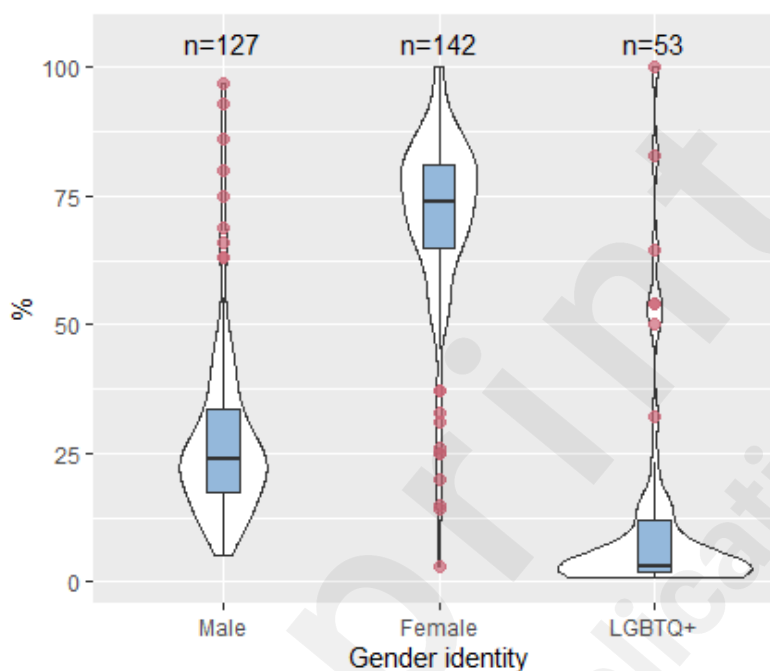


Figure 6: Gender split in experimental groups across all studies (n=145).

Marginalised groups

Three quarters (n=108, 75%) of all studies included marginalised groups in their study population (Figure 7). Minority ethnic groups were most frequently represented, with 82 (57%) studies including participants from a variety of ethnic groups (Figure 7). LGBTQ+ young people were the second most represented group in 53 (37%) studies (Figure 7). Only a very small proportion of studies included representation from other groups, including those who were unemployed (n=15, 10%), living in a rural area (n=13, 9%), socially or economically disadvantaged (n=8, 6%), low education level (n=6, 4%), neurodivergent individuals (5, 3%), living with a physical health condition (4, 3%), migrants or immigrants (n=3, 2%), low income (n=2, 1%), homeless (n=2, 1%), current or previous substance use issues (n=2, 1%), not in education or employment (n=1, <1%).

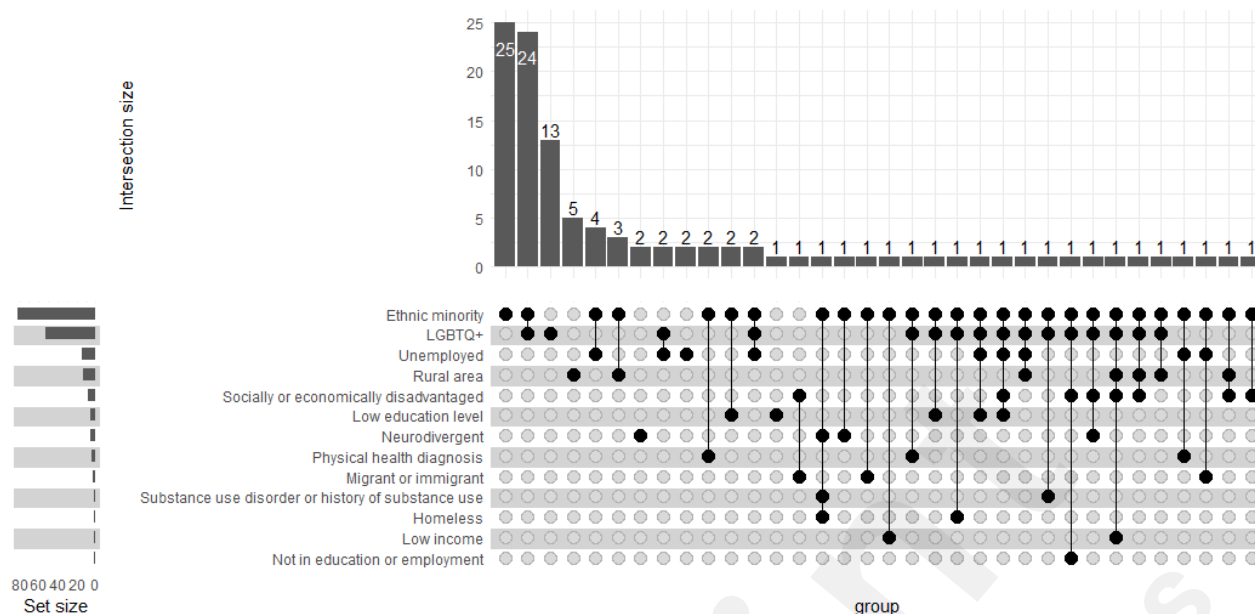


Figure 7: Marginalised groups represented across all studies (n=145)

Recruitment approach across main populations

Most studies using interventions targeted at the general population (n=63) adopted a digital only approach (70%), whereas studies that recruited people experiencing mental ill health symptoms (n=38) adopted a higher percentage of blended support (54%) and those that recruited people with a mental health diagnosis (n=27) utilised the highest proportion of blended human and digital supports (74%) (Figure 8). The type of blended approach varied across study populations, with researcher team support being the most common approach in the general population (12/19, 63%) Research team (9/21, 43%) and clinician support (9/21, 43%) were equally used in study populations of those with mental ill health symptoms. diagnosis. For those with a mental health diagnosis, clinician support was the most common (14/20, 70%).

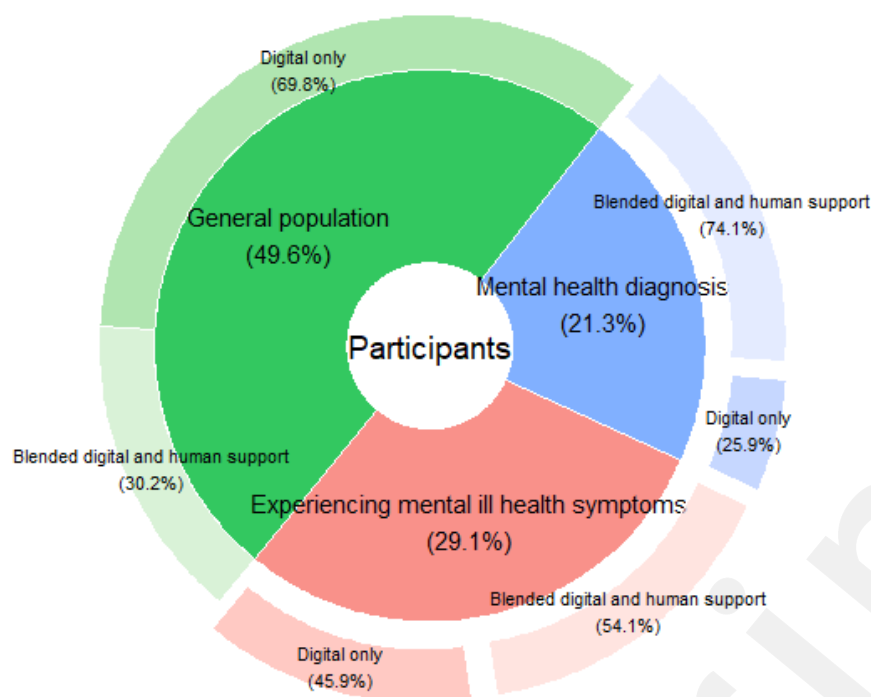


Figure 8: Breakdown of digital only versus blended human and digital support.

Modalities

Many of the interventions reported in the studies utilised multiple treatment modalities, and these differed depending on the population group (Figure 9). The most common modality was cognitive behavioural therapy (CBT), which was used in interventions across 63 (43%) studies, with 39 (27%) using CBT alone, and 24 (17%) using CBT in combination with another modality. The second most common treatment modality was mindfulness, which was used in interventions across 40 studies (25%), with 21 (13%) using mindfulness alone and 19 studies using mindfulness in combination with another treatment modality. The third most popular type was positive psychology, which was used in 21 (14%) study interventions, with 7 (5%) of those using positive psychology as the sole modality, and 14 (10%) using it with another combination of treatment.

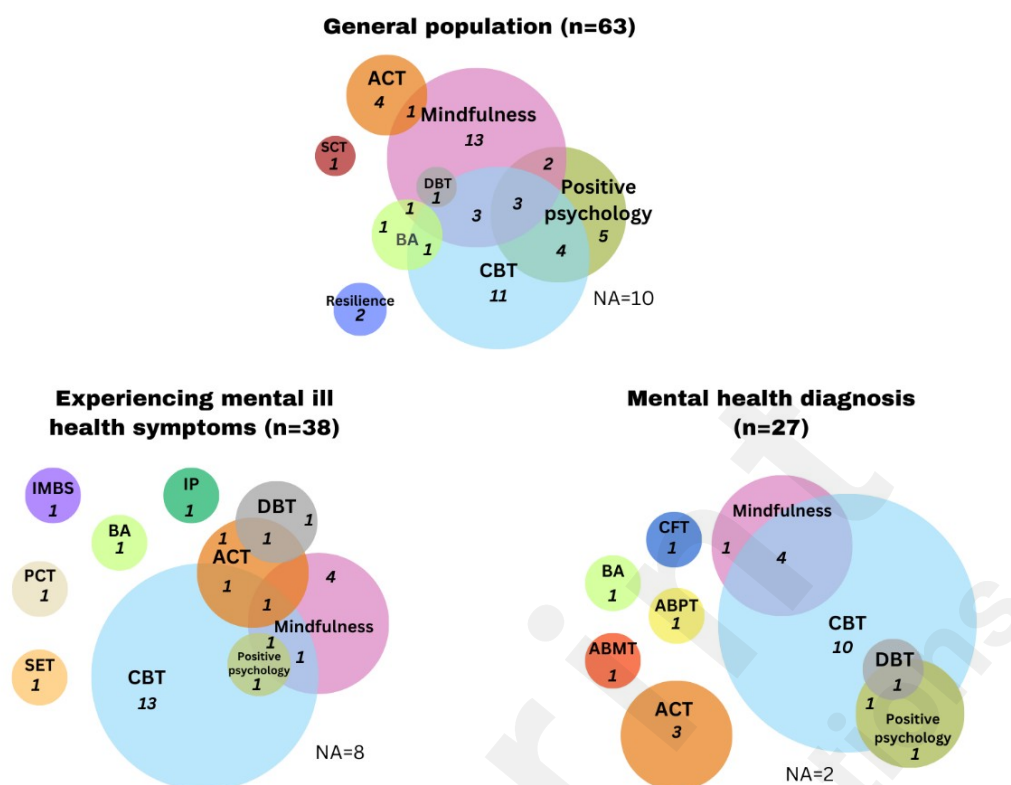


Figure 9: Treatment modalities used in digital mental health interventions across main participant groups. ABPT=affect-based psychodynamic therapy, ABMT= attention bias modification training, ACT=acceptance and commitment therapy, BA=behavioural activation, CBT=cognitive behavioural therapy, CFT=compassion-focused therapy, DBT=dialectical behaviour therapy, IP=interpersonal psychotherapy, IMBS= information-motivation-behavioural skills, PCT=perceptual control theory, SCT=social cognitive theory, SET=self-efficacy training.

Intervention features

In studies that recruited participants from the general population (n=63), the most common features used in digital interventions were psychoeducation/ education (44/63, 70%), mindfulness/ breathing exercises (37/63, 59%), and mood logging (20/63, 32%) (Figure 10).

For studies that recruited people experiencing mental ill health symptoms (n=38), the top features in digital interventions were the same, including psychoeducation/ education (n=32/38, 86%), mindfulness/ breathing exercises (17/38, 45%) and mood logging (16/38, 43%) (Figure 10).

In studies that recruited those with a mental health diagnosis or people that met diagnostic criteria (n=27), the most common features used in these digital interventions were psychoeducation/ education (21/27, 78%), mood logging/check in/ self-monitoring symptoms (16/27, 59%), and mindfulness/ breathing exercises (5/27, 25%) (Figure 10).

Personalisation or customisation was a more common feature seen in interventions for those experiencing mental ill health symptoms (6/38, 16%) or individuals with a mental health diagnosis (7/27, 26%), compared to the general population (5/63, 8%) (Figure 10). Self-help plans/ relapse plans were used more commonly for those experiencing mental ill health symptoms (4/38, 10%) or individuals with a mental health diagnosis (4/27, 15%), compared to the general population (1/63, 1%) (Figure 10). Gamification or reward incentives were used more often in interventions for the general population (15/63, 24%) and for people experiencing mental ill health symptoms (7/37, 19%) compared to interventions for those with a mental health diagnosis (1/27, 4%) (Figure 10).

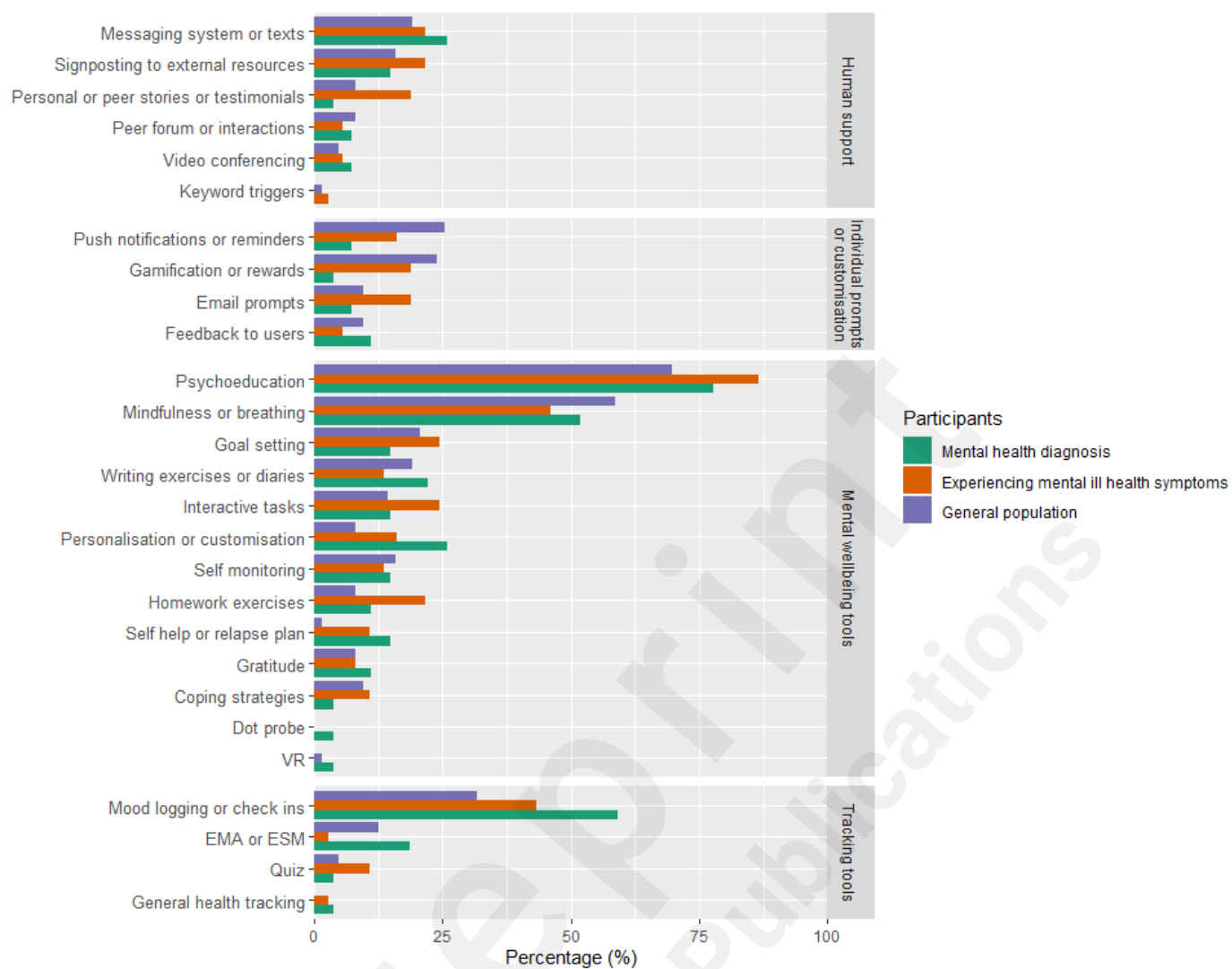


Figure 10: Intervention features across most common populations

RQ4: Retention

Retention rates ranged from 16-100%, with an average retention rate of 66% across all studies (SD=23%). Table 7 highlights the retention rates across study type, delivery, type of digital tool, study population and studies that included incentives versus those that did not.

Table 7: Retention rates across study characteristics

Characteristic	Type (n = number of studies)	Number of participants that started study Range, mean (SD)	Completed study-range (%)	Completed study-mean % (SD %)
Study type				
	Randomised control trial (n=81)	8-2222, 177 (305)	16-100	70 (22)
	Pilot study (n=19)	8-630, 69 (140)	24-100	79 (22)
	Feasibility study (n=16)	10-692, 77 (167)	19-100	66 (24)
Delivery				
	Digital only (n=77)	8-2327, 189 (370)	19-100	69 (23)
	Digital intervention with human support (n=68)	8-2222, 165 (319)	16-100	71 (23)
Type of digital tool				
	App (n=58)	10-2222, 121 (294)	33-100	76 (18)
	Web-based (n=43)	10-810, 176 (207)	19-100	64 (24)
	Website (n=23)	12-1982, 258 (436)	16-100	57 (25)
Study population				
	General population (n=63)	10-2327, 263 (444)	19-100	68 (23)
	Experiencing mental ill health	8-1982, 166 (328)	16-100	64 (22)

	symptoms (n=38)			
	Mental health diagnosis (n=27)	11-280, 53 (56)	32-100	76 (22)
Incentive				
	No incentive given (n=65)	8-2222, 193 (382)	16-100	65 (24)
	Any incentive given (n=80)	8-2327, 166 (318)	24-100	73 (21)

Studies with high retention rates

A total of 36 studies had very high retention rates, of 90-100% participants [55,59,64,65,67,71,73,75–77,80,82,83,86,93,98,101,105,112,122–124,129–131,133,139,153,158,161,165,170,173,174,183,188]. These studies recruited between 8-22 participants (mean=60, SD=52). They ranged from a single, one-off session to a 24-week trial period, with an average length of 6 weeks. Only 10 of these 36 studies recorded any follow up measures, anywhere from 2 weeks post study up to 12 weeks, with an average follow up time of 8.5 weeks post study. Roughly two thirds (22/36, 61%) of these studies gave participants any form of reimbursement such as financial and/ or course credit for students for completing the study.

Discussion

Principal results

This study sought to investigate the literature on digital mental health interventions for young people aged 16-25 in order to (i) establish the characteristics of studies (ii) the characteristics of digital mental health interventions offered to young people and the level of human support in combination with digital mental health (iii) the target populations of digital mental health interventions for young people (iv) the retention rates across studies involving digital mental health interventions for young people.

Studies were spread out globally, mostly originating in the United States of America (30%), Australia (11%) and the United Kingdom (10%), with a range of study types, mostly RCTs (56%) but the majority of studies had a control group (61%). Just under half of the digital mental health interventions focused on treatment (46%), with the rest focused on mental health promotion or prevention of mental health problems (54%). The average prescribed length of using an intervention was 6 weeks, and 43% studies recorded follow up data after the intervention period, most commonly at 12 weeks. Participant numbers varied hugely across studies, from 8 to 2,222 with a mean of 167, but with large standard deviation (303). Over half of the studies (55%) gave participants reimbursement for taking part, mostly financial incentives.

Interventions targeted mostly general mental wellbeing, depression, anxiety and/ or stress (64%). Apps (38%), web-based resources (33%) and websites (14%) were the most popular digital tools. Psychoeducational content (72%) and mindfulness or breathing exercises (52%) were most common across digital interventions generally. A total of 48% all studies used a blended approach combining human support with a digital intervention, while the other studies were digital only.

The largest group of participants across studies were young people from the general population without reported mental health issues (43%). The next most common group were those experiencing mental ill health symptoms (30%), followed by those with a mental health diagnosis or meeting

diagnostic criteria (18%). Among those diagnosed, most had anxiety or depression; 5 studies included participants with depression/ anxiety with other co-morbid mental health conditions, and 5 studies included participants with other mental health conditions. Convenience sampling was prevalent (97% studies), with universities and colleges the primary recruitment location. Three quarters of the studies included representation of young people from marginalised groups. Digital-only approaches were common for the general population, while blended human-digital support was more often utilised for those with mental ill health symptoms or a mental health diagnosis. CBT, positive psychology, and mindfulness were the most popular approaches in general population interventions, whereas digital interventions for mental health symptoms or diagnosis often used CBT or other specific therapeutic modalities. Gamification or reward incentives were more prevalent in general population interventions (24%) and with populations experiencing mental health symptoms (19%) and less so with individuals with mental health diagnoses (4%). Participants' average age was 20.8 across all studies. Females were largely overrepresented (71%), while males typically constituted 30% of the study populations. Only 19% of studies included LGBTQ+ representation, predominantly including transgender and non-binary individuals. In these studies, LGBTQ+ representation averaged 13%.

In terms of participants that completed the prescribed intervention, the average retention rate across all studies was 66% (SD=23%). Retention rates were higher than the mean for pilot studies (mean 79%), apps (mean 76%), studies that recruited participants with a mental health diagnosis (mean 76%) and studies that offered any type of incentive (mean 73%).

Limitations

In this review, some information was missing during data extraction as indicated in the results, for example twelve studies reported age range instead of average age, but largely most data were reported. As a scoping review methodology was employed, risk of bias was not conducted on the studies included, nor was an assessment on the efficacy or effectiveness of the digital mental health interventions. As a quality assessment was not conducted, this may affect the interpretation of findings regarding retention rates. Particularly as 44% of studies were not RCTs, considered the gold standard in research for evaluating effectiveness. Therefore, the finding that retention rates for pilot studies were higher (79% on average) compared to RCTs (70% on average) should be interpreted with caution. Given the heterogeneity of digital mental health interventions included in this study, a systematic review and meta-analysis was not a feasible option and thus it wasn't possible to assess effectiveness, however, future work could focus in on specific areas, for example apps for specific cohorts of young people to assess effectiveness. Despite the limitations, this scoping review gives an extensive insight into the current landscape of digital mental health interventions for young people, from mental health promotion and primary prevention to more targeted treatment interventions, and points towards useful areas for future research.

Comparisons with prior work

While roughly half of the current studies included in this review focus on treatment of common mental health problems, future work could direct more resources towards promotion and prevention measures to halt the escalation of mental ill health. The period of time between 18 to 25 years, represents a transitional phase marked by increased exposure to risk factors like instability, employment search, identity exploration, and heightened self-focus, elevating the risk of mental health conditions [193]. Thus, for young people it is important to focus on mental health promotion and prevention strategies, which range from universal, whole population approaches irrespective of current mental health status; selective approaches for specific risk factors; indicated approaches which focus on early sub-clinical symptoms; and finally to tertiary approaches which target specific

mental health conditions [194]. A recent meta-analysis found that use of digital mental health promotion tools among youth aged between 11 -18 resulted in small significant improvements in general wellbeing and small-medium significant improvements in anxiety [7]. Current literature indicates that universal approaches used within psychological or psychoeducational interventions may improve symptoms of anxiety, but may not prevent depressive or anxiety disorders [195]. Further research into digital mental health promotion for young people would be beneficial to strengthen these findings, given the heterogeneity of studies in this area.

Psychoeducational content and mindfulness/ breathing exercises were most commonly used across interventions, for all populations and throughout the studies there was a major focus on CBT and mindfulness-based approaches. While CBT is considered the gold standard for treatment as a previous systematic review and meta-analysis found that digitally delivered CBT interventions had greater effect sizes compared to other modalities [196], future interventions could utilise a broader spectrum of therapeutic models. Acceptance and commitment therapy (ACT), which is another type of third wave cognitive treatment, was used in a small proportion of studies, and has been previously demonstrated to be effective in enhancing and sustaining mental health outcomes across various demographics, however evidence of the clinical significance of these effects was lacking [197]. Given the scarcity of work that has been carried out, a future direction could be to run large scale trials to determine the effectiveness of other therapeutic modalities outside of CBT, or combined approaches, particularly in the digital mental health context. In addition to these therapeutic modalities, there is limited research of theoretical models informing digital mental health interventions, particularly for young people. A commentary paper provided a conceptual overview of how established behaviour theories and models, such as Health Belief Model, Theory of Planned Behaviour, Transtheoretical Model, and Social Cognitive Theory, can inform development of a digital intervention for individuals with mental ill health [198]. Naslund and colleagues suggested that individual characteristics should inform intervention design and shape the content, while theory should inform strategies to support behaviour change, which can be modified in real-time based on user feedback, and that theory can also guide outcomes to inform behaviour mechanisms and intervention modifications [198]. In 2020, the WHO published a framework for planning, developing and implementing youth-centred digital mental health interventions which mentions developing a theory-driven approach, but does not provide explicit details on how to approach this using psychological theory [199]. Further research is needed on how these theoretical approaches are adapted for digital delivery and their appropriateness for young people.

One of the most prominent results was the exclusion of more marginalised groups outside of ethnic minorities. However, it may be the case that there is underreporting of inclusion of marginalised groups as studies may not always capture this information when collecting participant demographic information. Based on the data used in this review, there was a lack of gender diversity and lack of representation from certain populations including young people who were unemployed, living in a rural area, socially or economically disadvantaged, had a low education level, neurodivergent, living with a physical health condition, migrants or immigrants, from low income, homeless, experiencing current or previous substance use issues, not in education or employment. These groups are often excluded from digital mental health studies, as convenience sampling is most often used, with participants most commonly being recruited through universities or colleges. In particular, LGBTQ+ young people often experience victimisation and have poorer mental health, and higher rates of self-harm and suicidal ideation compared to their cisgender and heterosexual peers [200,201]. Looking more broadly across the whole population in a UK mental health service, a recent study highlighted that certain vulnerable groups, including ethnic minorities, individuals with disabilities, those born outside of the UK and those with lower academic attainment were under-represented in psychological therapies on a national level [202]. Other previous work also identified that more

research is needed into preventative digital mental health interventions with young people from poor or underserved backgrounds [203]. It is clear that future work in this area should aim to be more inclusive, with representation from marginalised and vulnerable young people.

In addition, there was a lack of inclusion of a range of mental health conditions outside of anxiety and/or depression, given that only 5 studies focused solely on study populations of people with diagnoses that didn't include anxiety or depression. Previous systematic reviews on digital interventions for young people with anxiety and depression have found small to medium effect sizes when comparing digital interventions, most commonly using CBT modalities in comparison to a control group [31,32]. In addition, the studies targeting those with mental health diagnoses were relatively underpowered, with sample sizes falling short of the previously reported median of 106 participants in efficacy and effectiveness trials [204].

The average prescribed length of using an intervention was 6 weeks but huge variations from a single one-off session to 6 months, and only 43% studies recorded follow up data after the intervention period, again at different time points. Compared to traditional therapy, there are no consistent prescribed lengths for digital mental health interventions. Depending on the type of digital mental health intervention being delivered, future work could explore intervention lengths akin to that prescribed by psychological therapies services. For example, in the UK, the National Health service provides 'NHS Talking Therapies', formerly known as Improving Access to Psychological Therapies, which follows a stepped care model. Within this model, individuals experiencing mild to moderate mental ill health symptoms (step 2) would receive low intensity treatment, which could be up to six sessions with a mental health professional. There is also a lack of long term follow up data in over half of the studies, which would make it difficult to track sustained changes in mental health over time. Future work should look at standardising the length of treatment within digital mental health interventions, and including long term follow up data to help determine the efficacy or effectiveness of digital tools, compared to traditional face-to-face mental health support.

The average completion across all studies was 66%, which falls slightly short of the weighted average of 69% reported for retention of internet-based mental health interventions [205]. In comparison to other studies in this field, an average of 74.8% young people aged between 11-18 completed mental health promotion interventions with a digital component (10) and 80% of children and young people used digital health interventions and/ or completed the follow-up measures [20]. The average rate found in the present study is also comparable with other studies on youth mental health interventions generally that didn't involve a digital component, for example a study that examined interventions for young people at risk of psychosis reported a pooled retention rate of 66% [206]. For long-term clinical studies, a rate of 80% or higher is considered acceptable or high completion [207], so there is still room for improvement. Sustaining engagement with digital mental health interventions in real world settings outside of randomised controlled trials is even more challenging, as highlighted by Fleming and colleagues [208], only 0.5% to 28.7% of users from the general population completed or continually used self-help interventions for anxiety and depression. Some previous strategies have been identified to recruit young people and keep them engaged in longitudinal health research, such as recruitment through social media, including financial incentives for taking part, joining with peer groups, and incorporating data collection that is user friendly and flexible, and young people also emphasised the importance of social connection with both peers and the research team [209]. Another study that examined at barriers and facilitators to engagement with digital health interventions (DHIs) usage of those ages of 2-25 found that children and young people preferred DHIs with features such as videos, limited text, personalisation, ability to connect with others, and options to receive text message reminders [20]. An important area for future work will be to identify or incorporate better strategies to improve engagement and completion, particularly for marginalised populations. The main recommendations for the field based on key findings in this

review can be found in Table 8, which includes general recommendations for future research, as well as relevant findings for clinicians, technology developers and policymakers.

Table 8: Recommendations for future work based on key findings in this review.

Recommendation	Key findings
General recommendations for future research	
Expand Research in Underrepresented Regions More research is needed in low- and middle-income countries to ensure digital mental health interventions are accessible and culturally relevant across diverse global populations.	The majority of studies were conducted in high-income countries, particularly the USA, Australia, and the UK.
Enhance Study Design and Follow-Up Assessments Future research should incorporate multiple follow-up assessments to evaluate the sustained impact of interventions beyond the intervention period.	Over half of the studies were randomised controlled trials, but fewer included long-term follow-ups.
Improve Diversity and Inclusion in Participant Recruitment Efforts should be made to recruit participants from more diverse backgrounds, including ethnic minorities, low-income populations, neurodivergent individuals, and those living in rural areas. Additional demographic information should be recorded to confirm inclusion.	Most studies relied on convenience sampling from universities and online platforms, limiting representation.
Address gender imbalance in study samples. Aim for a more balanced gender distribution to understand the effectiveness of digital interventions across all genders.	Females were largely overrepresented in study populations (71% on average), and LGBTQ+ young people were only included in 37% of studies overall.
Recommendations for clinicians	
Increase Focus on Blended Human-Digital Approaches Blended approaches, particularly for individuals with mental health diagnoses, could be prioritised to improve engagement and outcomes.	While 52% of interventions were fully digital, nearly half (48%) included some form of human support.
Standardise and Validate Outcome Measures Greater consistency in validated measures is needed to assess intervention effectiveness reliably.	Studies used a variety of mental health scales, making it difficult to compare results.
Tailor Digital Interventions to Specific Mental Health Needs More targeted interventions should be developed to support individuals with severe or complex mental health	While general mental well-being was the most common target along with anxiety, depression and stress,

conditions outside of anxiety and depression.	specific conditions such as PTSD and psychosis were underrepresented.
Recommendations for technology developers	
Encourage Multi-Component Interventions Combining multiple elements, such as interactive tasks, gamification, and peer support, may enhance engagement.	The most common intervention features were psychoeducation, mindfulness, and mood tracking..
Leverage Emerging Technologies for Mental Health Future research could explore the potential of advanced technologies to enhance engagement and personalisation.	Apps and web-based resources were the dominant modalities, with minimal use of virtual reality, chatbots, or AI-driven interventions.
Recommendations for policymakers	
Increase Accessibility and Affordability Future interventions could focus on cost-effective solutions that remain accessible without financial incentives.	Over half of the studies provided financial incentives, which may not be sustainable in real-world implementation.
Promote Implementation in Real-World Settings Future research should explore how digital tools can be integrated into healthcare systems, schools, and workplaces for broader reach and long-term sustainability.	Many interventions were tested in research environments but lacked real-world application.

Conclusions

In conclusion, this scoping review has provided a comprehensive overview of digital mental health interventions for young people aged 16-25. It has highlighted the global spread of studies, focusing on treatment, prevention and promotion of mental health. The scoping review sheds light on the need for greater inclusivity in research given the high proportion of females recruited, often from universities through convenience sampling. The review also highlights a lack of representation from marginalised groups and emphasises the importance of longer-term follow-up data to assess the efficacy and effectiveness of these interventions. Additionally, the review highlights challenges in sustaining engagement and completion, particularly outside of controlled trials, and suggests the importance of incorporating better engagement strategies, especially for marginalised populations. Overall, this review calls for a more inclusive and comprehensive approach to digital mental health interventions for young people.

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Data availability

The dataset containing data extracted from the 145 studies included in this review can be found in Appendix 3.

Author contributions

Four authors (CP, TW, CK and AMC) reviewed the title/ abstracts of all retrieved articles. Three authors (CP, TW and CK) conducted the full text screening. At both stages of title/ abstract screening and full text screening, conflicts were resolved by discussing papers. Two authors (CP and TW) agreed on the data extraction template and one author (CP) later refined the template. Two authors carried out data extraction (CP and CK), and one author (CP) reviewed the data extraction and completed the consensus template. The data extracted included basic study information (author and year, location), sample characteristics (age, gender, number of participants, where participants were recruited, study population, inclusion or exclusion of marginalised groups), intervention details (target area, digital only or blended digital and human support, type of digital tool, main features, psychological modalities used within the intervention), and other study/ intervention details including outcome measures, scales used, the prescribed duration of the intervention, completion, financial incentives or other reimbursement, and type of intervention (promotion, primary prevention, intervention). One author (CP) analysed the data extracted from all papers. All authors were involved in the study design and writeup of the manuscript.

Conflicts of Interest

None declared

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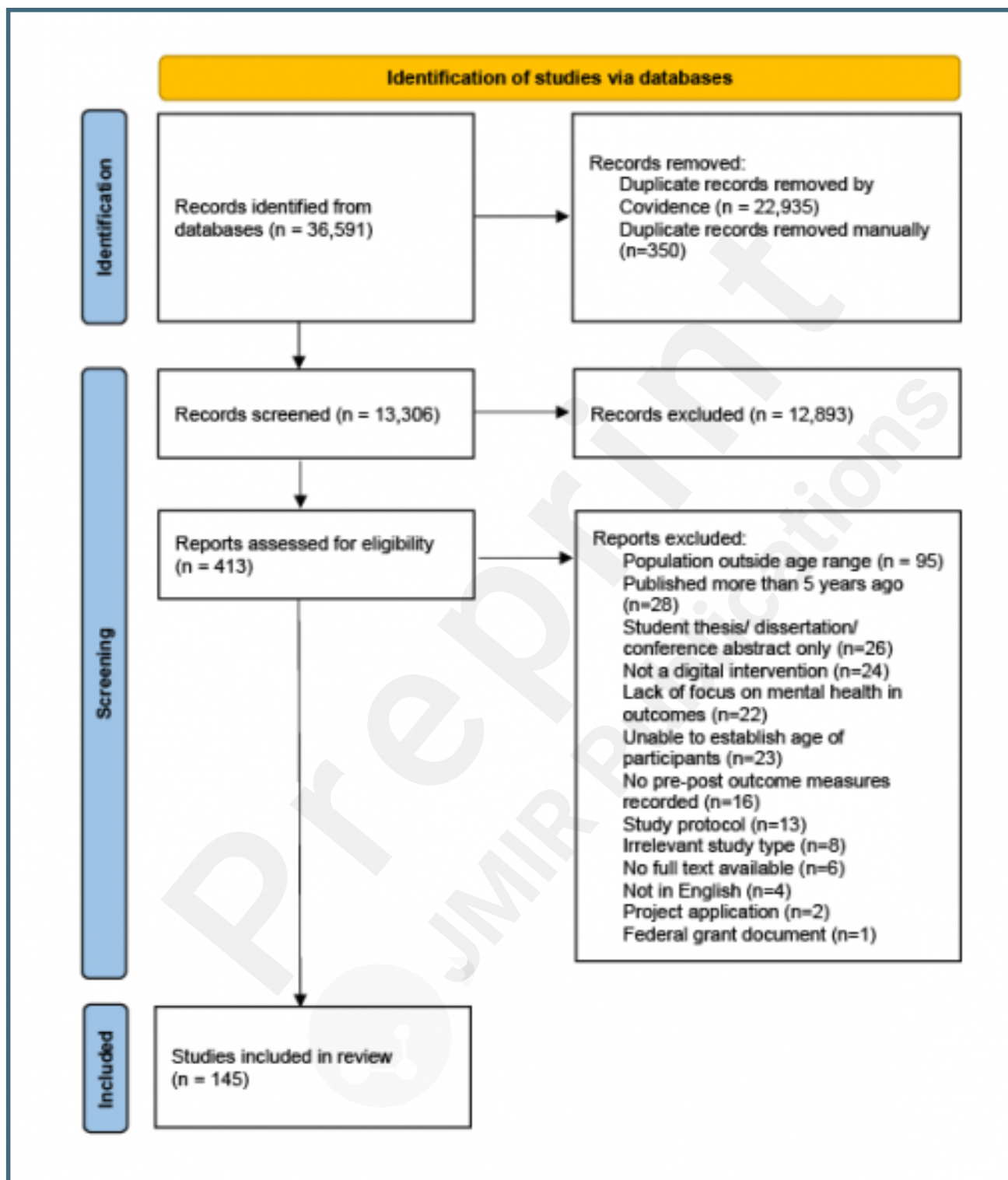
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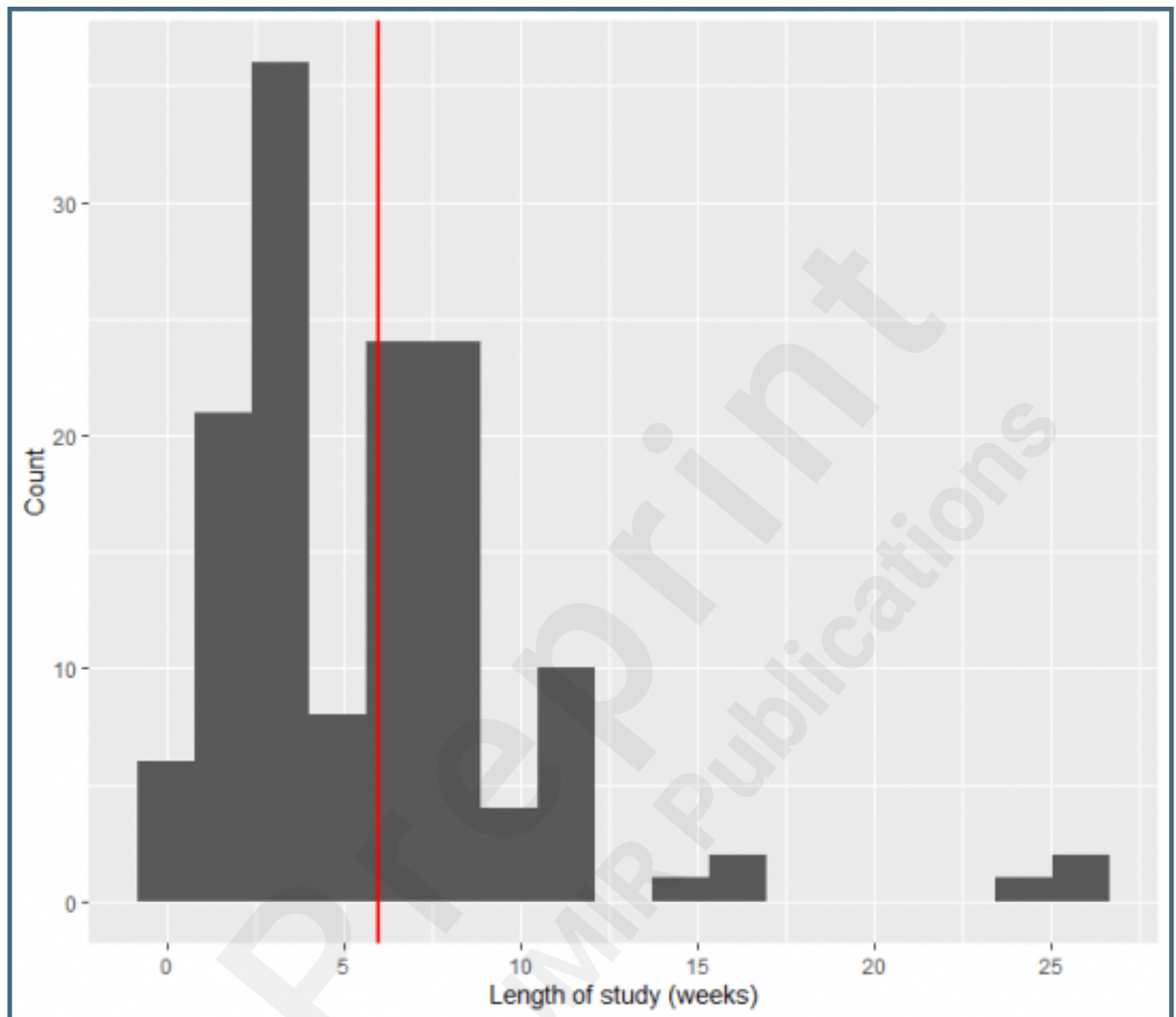
Supplementary Files

Figures

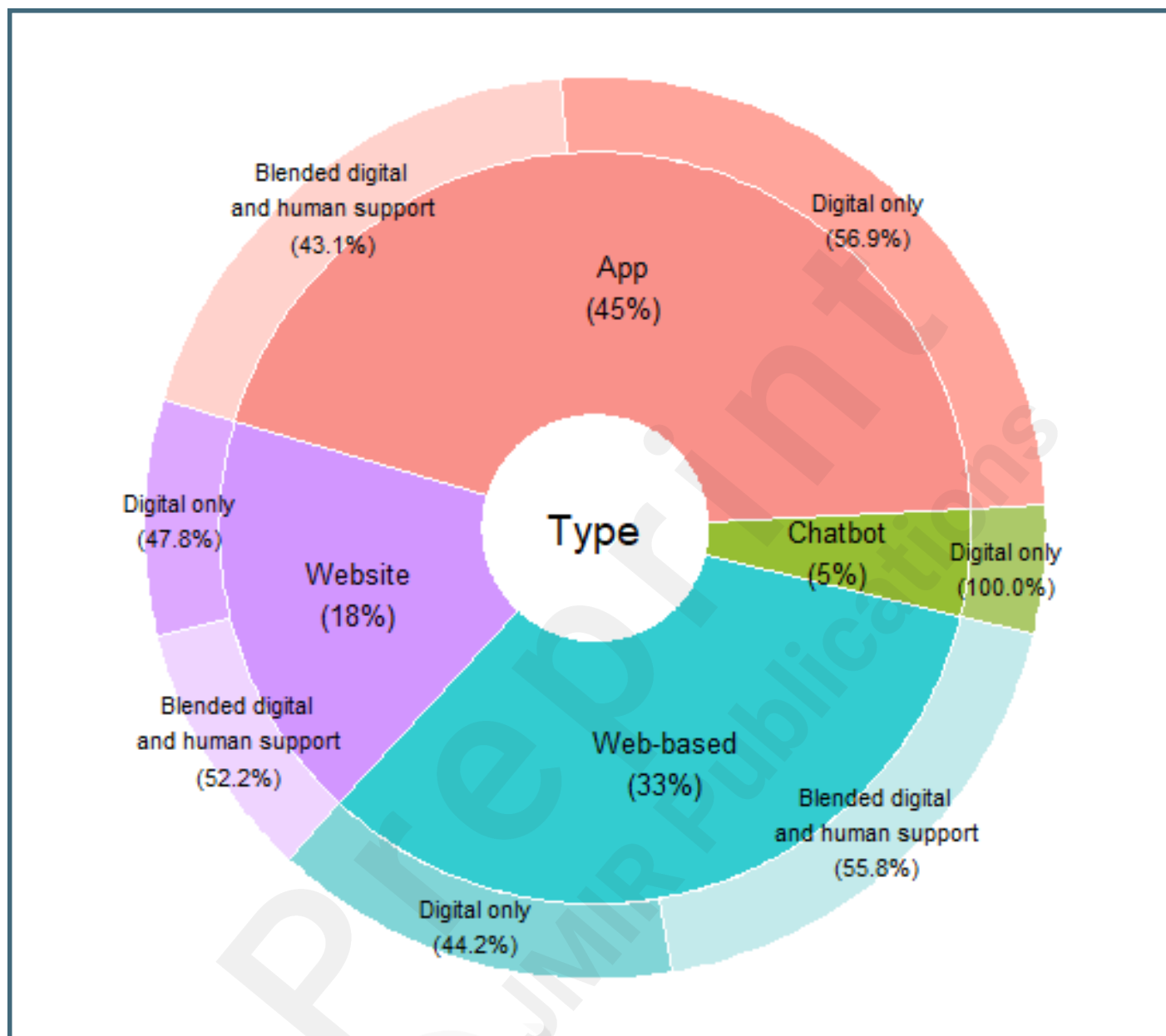
PRISMA diagram.



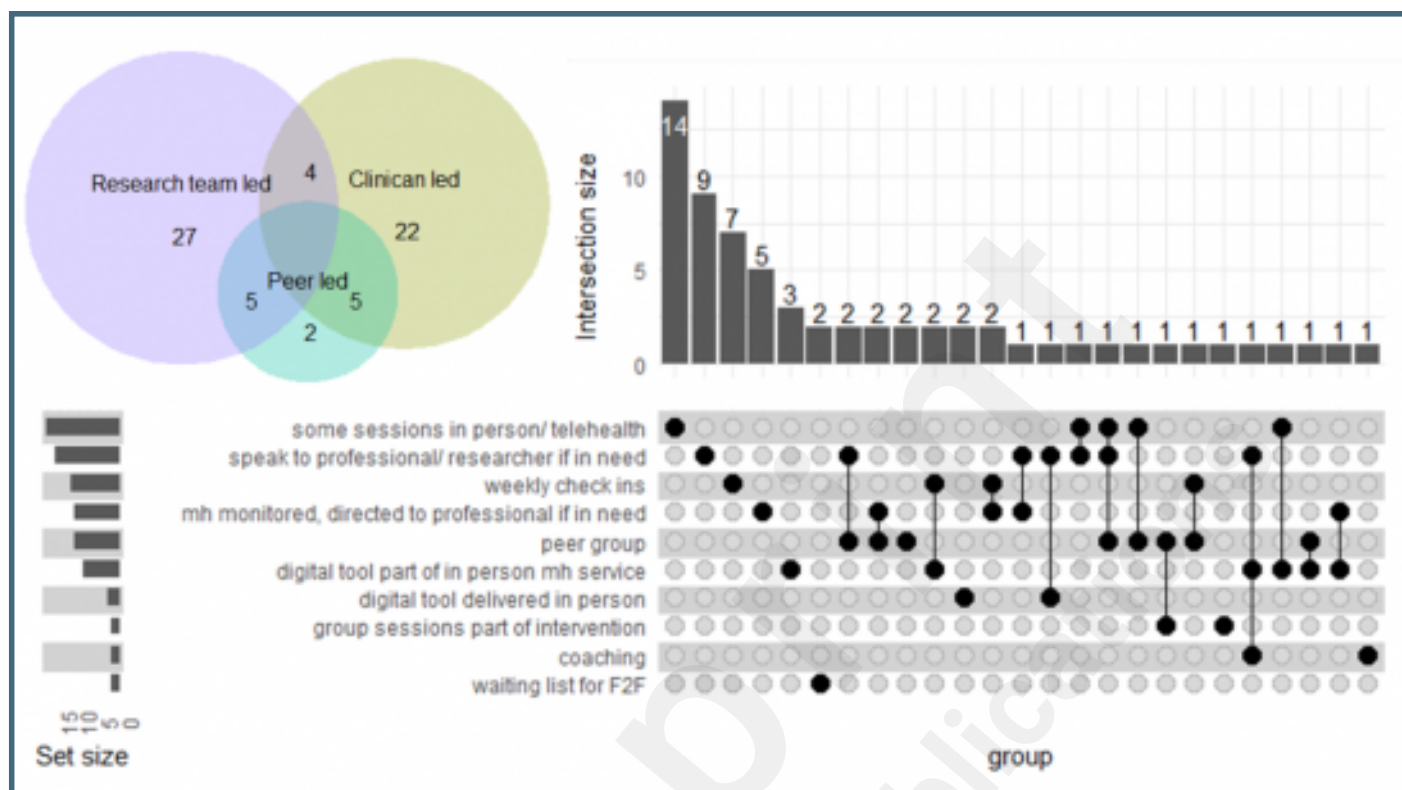
Intervention duration across studies. Red line = mean study duration.



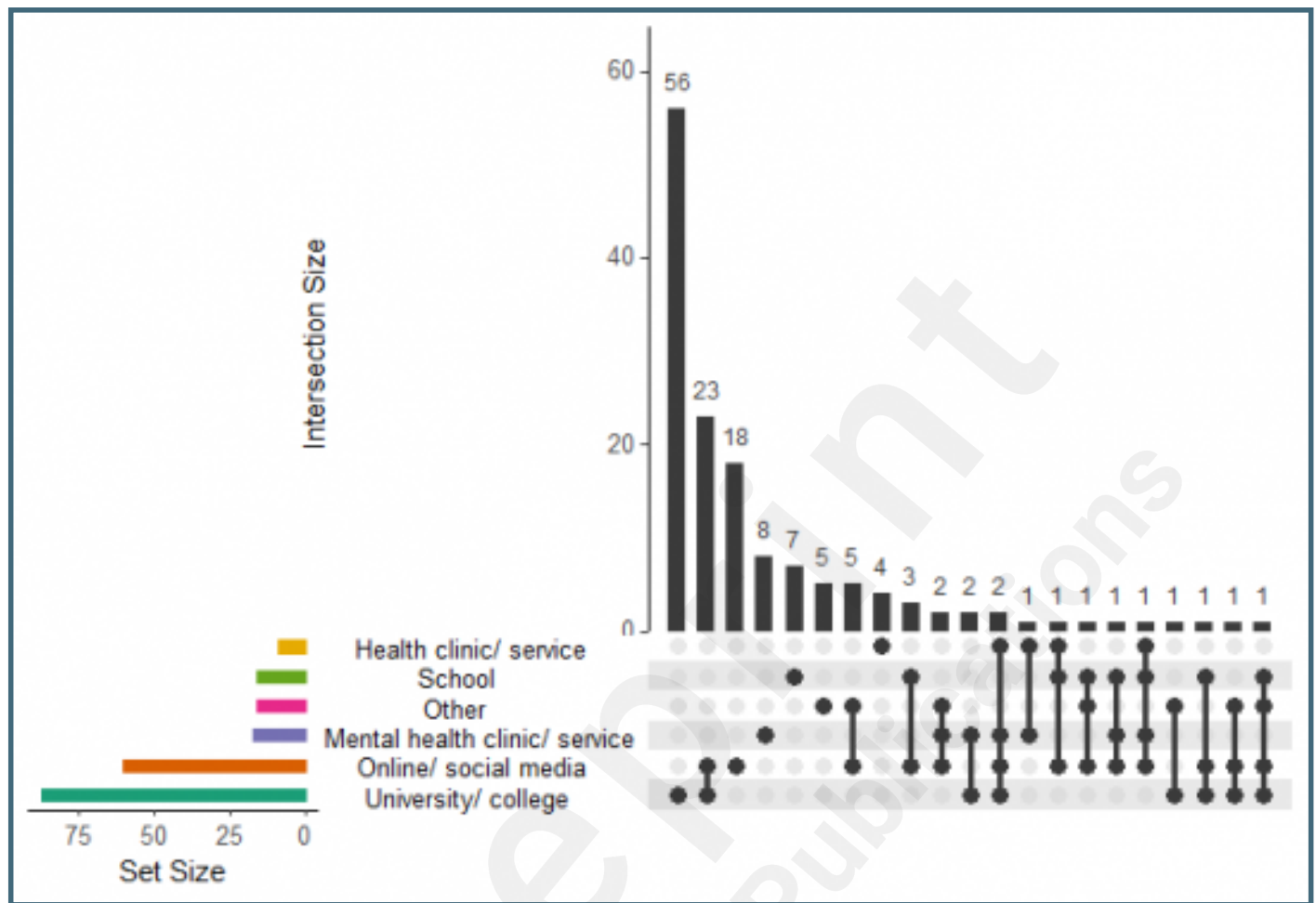
Delivery of intervention across different types of digital tool (n=135 studies included).



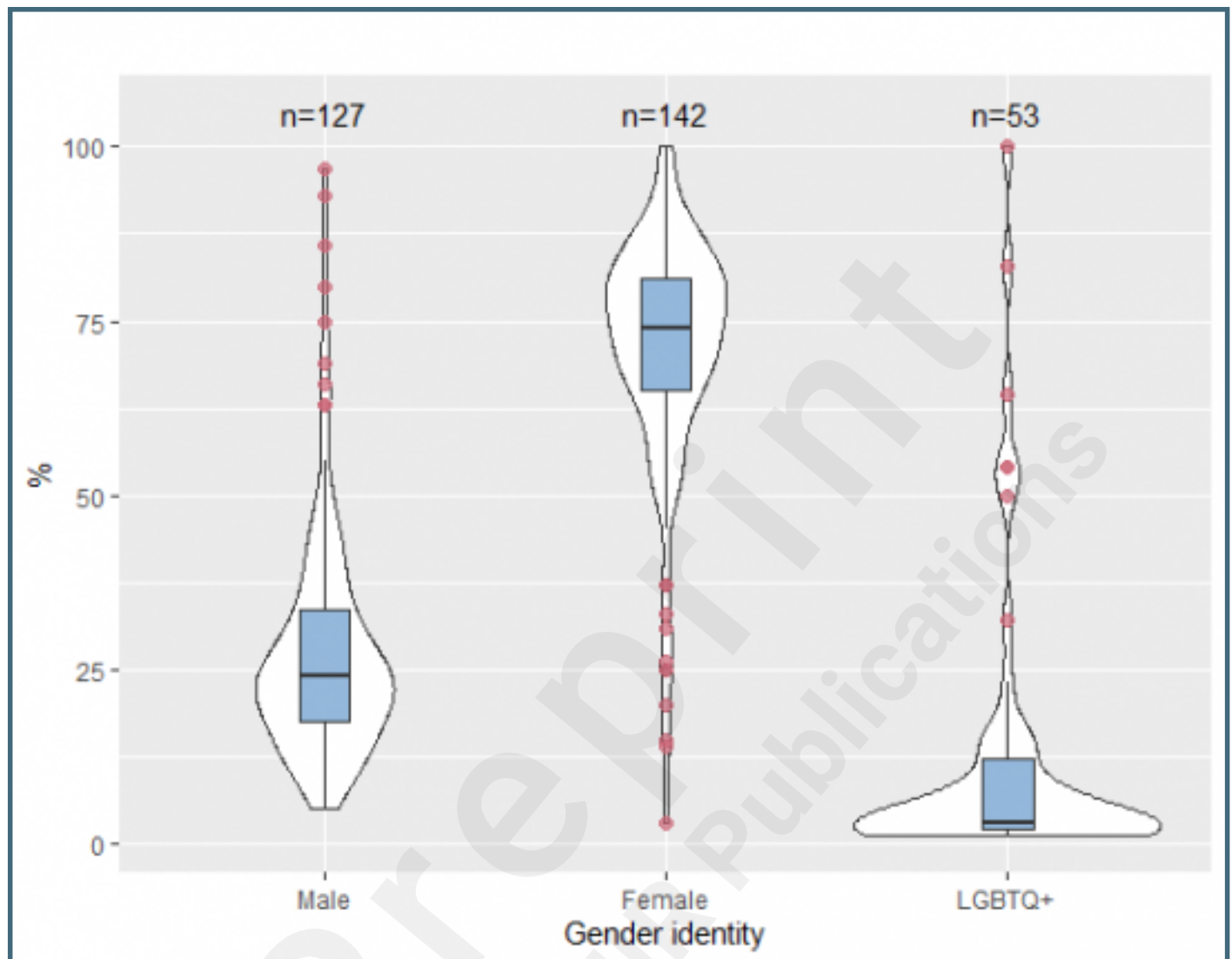
Type of blended interventions used across studies (n=65). Venn diagram showing overlap between peer, clinician and research team support. Upset plot showing degree of overlap between specific types of blended support (mh= mental health, F2F=face-to-face).



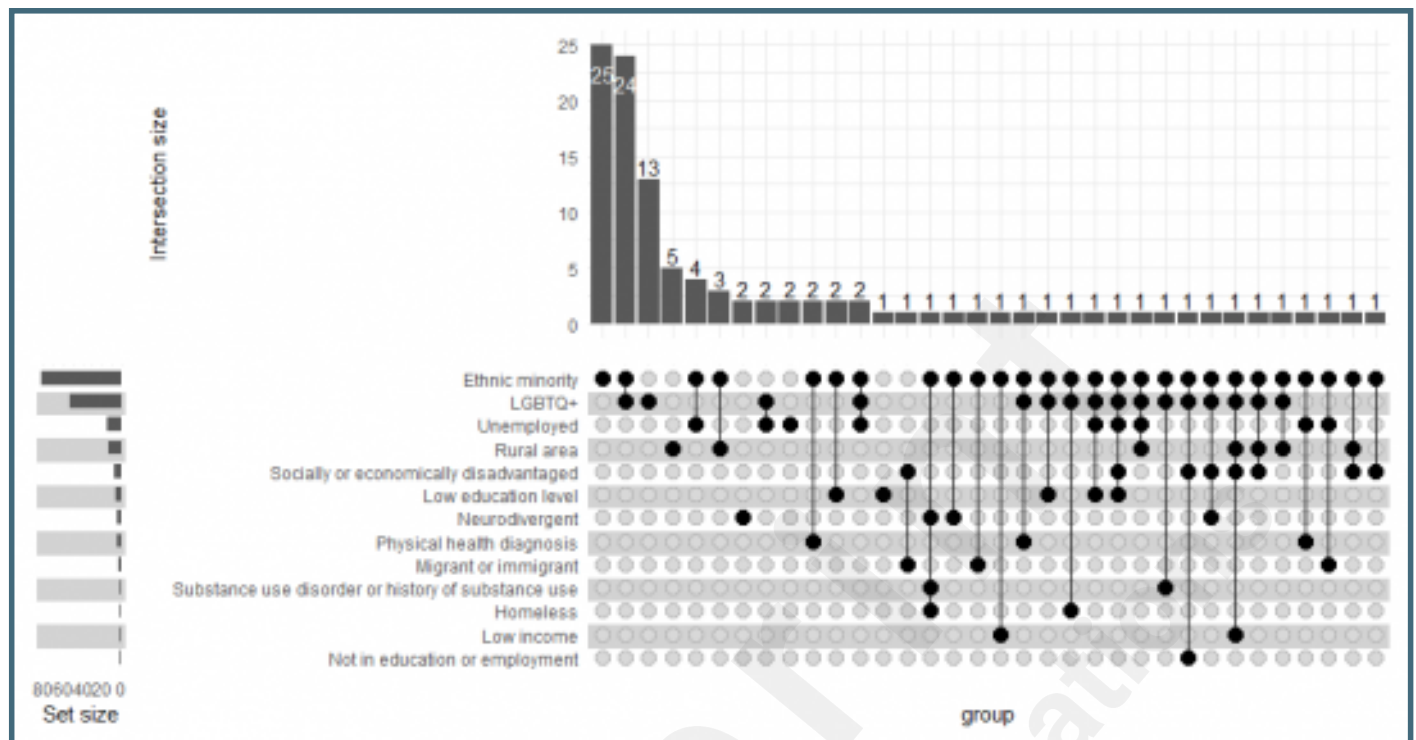
Participant recruitment sources across all studies.



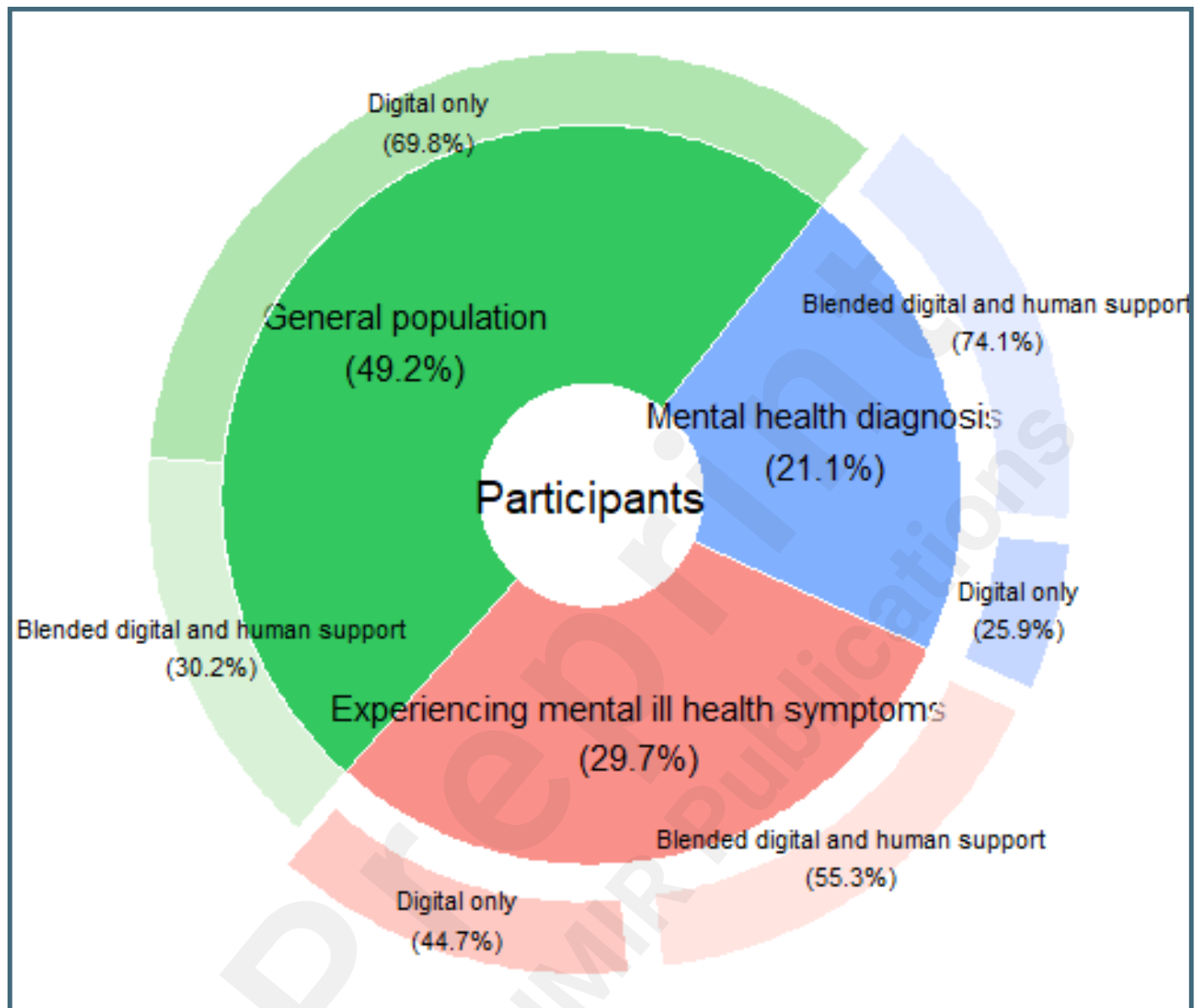
Gender split in experimental groups across all studies (n=145).



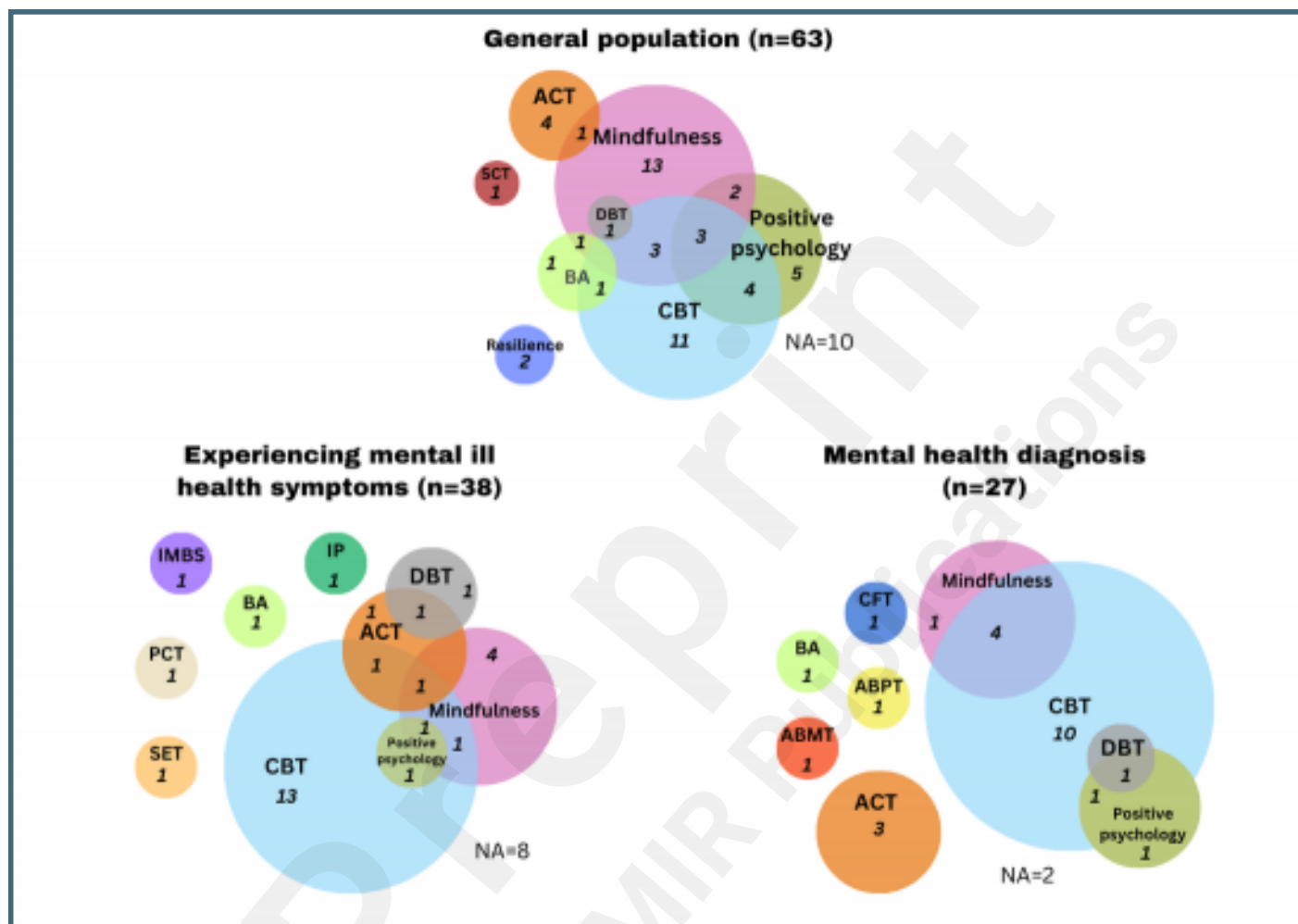
Marginalised groups represented across all studies (n=145).



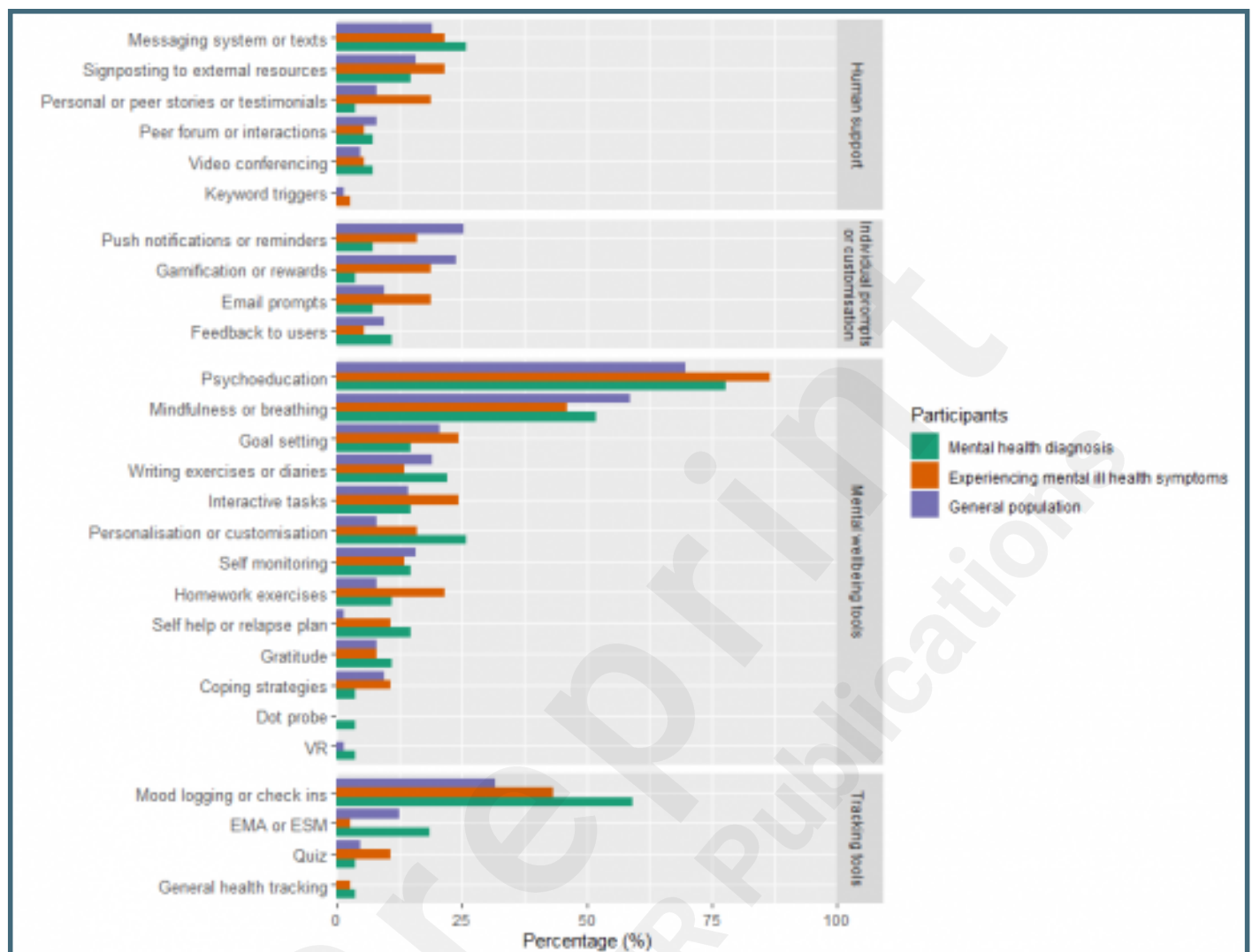
Breakdown of digital only versus blended human and digital support.



Treatment modalities used in digital mental health interventions across main participant groups. ABPT=affect-based psychodynamic therapy, ABMT= attention bias modification training, ACT=acceptance and commitment therapy, BA=behavioural activation, CBT=cognitive behavioural therapy, CFT=compassion-focused therapy, DBT=dialectical behaviour therapy, IP=interpersonal psychotherapy, IMBS= information-motivation-behavioural skills, PCT=perceptual control theory, SCT=social cognitive theory, SET=self-efficacy training.



Intervention features across most common populations.



Multimedia Appendixes

Search strategy and example of search in Scopus.

URL: <http://asset.jmir.pub/assets/e7153615b8c40ab378a7e78c21deb378.docx>

PRISMA-SR checklist.

URL: <http://asset.jmir.pub/assets/d758da4fa368c9d405d0c4c87910c7dc.pdf>

Data extracted from all 145 studies.

URL: <http://asset.jmir.pub/assets/0ec54049c1ee45c4890d82a49ccb603d.xlsx>

