

Understanding what we know so far about young people's engagement with wellbeing apps. A scoping review and narrative synthesis

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Abstract

Background: Increased levels of wellbeing contribute to people being more productive, resilient, physically healthy and showing lower levels of mental illness. Using mobile apps to increase wellbeing in young people is becoming the method of choice. This study sought to critically appraise the current evidence base with regards to young people's (16–24 years of age) engagement with wellbeing *apps*.

Methods: A systematic review of the literature and narrative synthesis was conducted to investigate users' characteristics and other potential engagement elements. A total of 11,245 titles, 160 abstracts and 68 full-text articles published between 2002 and 2021 were screened, of which 22 studies were included.

Results: Main themes/findings indicated that a user's engagement with wellbeing *apps* was dependant on the presence of strong identity elements, including motivation, mood and values; design elements such as meaningful rewards, short duration of studies and seamless automatic delivery with low contact with researchers; and being innovative and contextualised. The majority of the studies did not report outcomes by social determinants such as ethnicity, education and others.

Conclusion: This research reflects on the need to consider participants' individuality when designing *app* mediated wellbeing interventions.

Keywords

apps, young people, wellbeing, identity, engagement

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Introduction

Young people face numerous challenges when it comes to their mental health, with high levels of depression, anxiety, suicide and personality disorders reported.^{1,2} These conditions are aggravated by poor health behaviours including risk taking, drugs, alcohol and lack of physical activity,³ all heightened by the recent COVID-19 pandemic, which has caused further mental health deterioration and risky behaviours in young people.⁴ A novel way of addressing these issues developed over the last decade is using mobile health (mHealth – using current and emergent technologies to deliver and support treatment⁵). It is generally considered that young people have a particular affinity to use technologies such as

the internet and smartphones, with many researchers even considering them as 'natural users'.⁶ Given the intensity of mobile phone use by young people, the potential of using mobile applications (*apps*) for improving health must not be underestimated,⁷ not only with regards to addressing diagnosable disorders but also at a behaviour modification level.⁸ Mobile apps

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Table 1. Included studies.

Article	Authors
1 Augmented reality games as a new class of physical activity interventions? The impact of Pokémon Go use and gaming intensity on physical activity	Ni MY, Hui RWH, Li TK, Tam AHM, Choy LYL, Ma KKW, Cheung F, Leung GM
2 Well-being tracking via smartphone-measured activity and sleep: cohort study	DeMasi O, Feygin S, Dembo A, Aguilera A, Recht B
3 The impact of exercise motives on adolescents' sustained use of wearable technology	Deranek K, Hewitt B, Gudia A, McLeod A
4 Improving adolescent fitness attitudes with a mobile fitness game to combat obesity in youth	Lu F, Turner K
5 'Pokemon Go!' may promote walking, discourage sedentary behavior in college students	Barkley JE, Lepp AG, Ellen L
6 Continuous use of fitness apps and shaping factors among college students: a mixed-method investigation	Zhang X, Xu X
7 MindSurf: a pilot study to assess the usability and acceptability of a smartphone app designed to promote contentment, wellbeing, and goal achievement	Carey TA, Haviland J, Tai SJ, Vanags T, Mansell W
8 The utility of wearable fitness trackers and implications for increased engagement: an exploratory, mixed methods observational study	Lewis ZH, Pritting L, Picazo AL, Tucker MJM
9 Does it promote physical activity? College students' perceptions of Pokémon Go	Yan Z, Finn K, Breton K
10 Wearable activity trackers usage among university students	Ráthonyi G, Ráthonyi-Odor K, Bendíková E, Bácsné Bába E
11 Using a mobile social networking app to promote physical activity: a qualitative study of users' perspectives	Tong HL, B Health, Coiera E, Laranjo L
12 Smartphone delivery of a hope intervention: another way to flourish	Daugherty DA, Runyan JD, Steenbergh TA, Fratzke BJ, Fry BN, Westra E
13 Apps for IMproving FITness and increasing physical activity among young people: the AIMFIT pragmatic randomized controlled trial	Direito A, Jiang Y, Whittaker R, Maddison R
14 Feasibility of gamified mobile service aimed at physical activation in young men: population-based randomized controlled study (MOPO)	Leinonen AM, Pyky R, Ahola R, Kangas M, Siirtola P, Luoto T, Enwald H, Ikaheimo TM, Roning J
15 Promoting physical activity using a wearable activity tracker in college students: a cluster randomized controlled trial	Kim Y, Lumpkin A, Lochbaum M, Stegemeier S, Kitten K
16 The connecting health and technology study: a 6-month randomized controlled trial to improve nutrition behaviours using a mobile food record and text messaging support in young adults	Kerr DA, Harray, AJ, Pollard CM, Dhaliwal SS, Delp EJ, Howat PA, Pickering MR, Ahmad Z
17 The effects of a bike active video game on players' physical activity and motivation	Pasco D, Roure C, Kermarrec G, Pope Z, Gao Z

(continued)

Table 1. Continued.

Article	Authors
18 Fitness mobile apps positively affect attitudes, perceived behavioral control and physical activities	Gabbiadini A, Greitemeyer T
19 Use of wearable technology and social media to improve physical activity and dietary behaviors among college students: a 12-week randomized pilot study	Pope ZC, Barr-Anderson DJ, Lewis BA, Pereira MA, Gao Z
20 An mHealth intervention using a smartphone app to increase walking behavior in young adults: a pilot study	Walsh JC, Corbett T, Hogan M, Duggan J, McNamara A
21 A randomized controlled trial of multiple versions of an acceptance and commitment therapy matrix app for well-being	Krafft J, Potts S, Schoendorff B, Levina ME
22 Effects of a mindfulness meditation app on subjective well-being: active randomized controlled trial and experience sampling study	Walsh KM, Saab BJ, Farb NAS

have been shown to be effective to support treatment in conditions such as diabetes,⁹ smoking cessation,^{10,11} alcohol dependence,¹² weight management¹³ as well as psychological distress.^{14–17} However, apps also provide new opportunities to address preventative and strength focused interventions to improve wellbeing levels.¹⁸

Wellbeing is a broad concept that encompasses different areas, including psychological, emotional and physical dimensions.^{19,20} From a positive psychology (PP) perspective, high levels of wellbeing have been related to life satisfaction, positive emotion, higher productivity and increased life meaning, and in turn less psychological distress.^{19,21,22} Although the field is experiencing growth, within mHealth there are very few studies focusing on wellbeing as defined by PP as its own independent category. In that context, studies that use technology as the privileged medium to deliver those interventions to young people are even fewer, with poor engagement²³ and high attrition plaguing research.²⁴

As much as wellbeing *apps* have the potential to be effective, they remain fruitless if participants fail to engage. In an attempt to cast the net broadly *apps* are usually designed as ‘one-size-fits-all’ to cater for as many people as possible.²⁵ The results of doing this, however, are mixed and usually insufficient for *apps* in the wellbeing category. Different approaches to address this issue have been proposed; some focus on design such as usability²⁶ and gamification,^{7,27} while others are starting to look deeper into the individual differences of users.²⁸ The authors set out to understand individual user differences to explain why young people engage with wellbeing *apps* and provide insights into what could be done to increase engagement with these resources.

Method

A systematic review of 13 databases was undertaken to identify literature that focused on improving the wellbeing of young people using mobile *apps*. A narrative synthesis was

completed to group together and describe those characteristics that contribute to engagement.

Search strategy

Studies were identified through a comprehensive search of multiple databases designed in consultation with a professional librarian (RD) in collaboration with the principal reviewer (GA) (see Appendix A for search results). The search strategy included searching titles, headings and text and was tested to ensure it captured the intended type of studies. Databases were consulted from 2002 until 2021; this date range was chosen as 2002 was the year a smartphone with extensive data connectivity was developed in the United States,²⁹ although smartphones as currently known took longer to develop it was decided to cover a higher date range to ensure all relevant studies were captured. The databases consulted for this review were: ACM Digital Library, IEEE Xplore, Informit, ProQuest, Cochrane Library, Pub-Med, Current Contents Connect, Web of Science Collection, Scopus, Medline (Ovid), Psychinfo (Ovid) and CINAHL. No limitations on place of publication were used; however, the search was limited to only those studies published in English. A search using specialised databases: NDLTD- Cochrane library, ISRCTN, ANZCTR, APA PsycExtra, Open Grey, HSE, CADTH, AHRQ as well as manually searching through the JMIR journal (mHealth for wellness, behaviour change and Prevention) and Google scholar was also performed to identify any grey literature otherwise not captured in peer-reviewed databases. As per latest recommendations, the first 200 Google Scholar results were retained and screened.³⁰

Selection of studies

Studies were collected using Endnote³¹ as the reference management software. After filtering for duplicates, the

selection process followed 3 stages: initially a broad selection filtered unrelated papers based on their title and key words, next a more in-depth search included reviewing abstracts and finally pre-selected papers were accepted or rejected based on full content. Two authors, GA and AV, completed the process. GA consulted with AV about any ambiguous studies at each step of the selection, and any disagreement regarding relevance of the abstracts was resolved through discussion.

Inclusion criteria. Type of studies: Given the focus on understanding the characteristics of wellbeing *app* users, both quantitative and qualitative papers that focused on this area were included. Studies selected encompassed randomised controlled trials, quasi-experimental studies and longitudinal studies. For this study, wellbeing *apps* were defined in the framework of the complete state model of mental health (CMH) proposed by Keyes and Lopez.³² In that context any mobile *app* that addresses positive functioning across the categories contemplated in the model was defined as a ‘wellbeing app’. This includes purposely designed *apps* within the mentioned theoretical framework as well as any other *app* targeting behaviours consistent with this approach; these include general health and lifestyle *apps* commercially designed and freely available online. Papers were not selected based on reporting engagement specifically. The list of papers selected and their authors are presented in Table 1.

Participants: Participants were young people 16–24 years old as defined by the Australian National Survey of Mental Health and Wellbeing.³³ We did not exclude studies based on participant characteristics such as their nationality, gender or any other demographic indicator.

Phenomena of interest: Young people’s engagement with wellbeing *apps*, including those commercially available as well as custom designed. Comments on the completion of research were also gathered as a potential proxy to understand engagement with the *apps*.

Exclusion criteria

Studies excluded were as follows:

1. Designed as clinical interventions for already existing conditions: for example, depression, anxiety, obesity, smoke cessation, alcohol, diabetes, cancer, etc.
2. Out of the selected age range. As most studies did not fit precisely with the specified age range (16–24 years old), the mean age was taken as a valid reference, including the standard deviation where reported.
3. Primarily web based instead of *app* focused: *app* usage was considered as the main intervention strategy given their potential to work as standalone, mobile tools.
4. Studies that used intensive researcher interaction with participants (e.g. sms and phone calls) over and above the use of *apps* as their main intervention strategy.

5. Study protocols or design studies with no implementation or results.

Keywords

Handheld computer OR App/s OR Applications OR Mobile OR Cell Phone OR Accelerometer OR Actimetry AND Health AND Behaviour/s OR Physical Activity OR Fitness OR Walk/ing OR Eating OR Diet OR Weight OR Wellbeing OR Wellness OR Sleep OR Food consumption OR Energy AND Expenditure OR Mood OR Emotion

Assessment of methodological quality and data extraction

Included studies were critically appraised using four widely accepted checklists from the Joanna Briggs Institute³⁴ (Appendix B). The checklists aim to assess the quality of each study’s methodology referring to important elements of study designs including randomised, observational (non-randomised) and qualitative studies. These tools include aspects such as the randomisation of participants into groups, methods employed to assess intervention outcomes, the appropriateness of statistical analyses used, the employment of appropriate search strategies and the critical appraisal of studies and methods used to minimise errors in data extraction. Two authors (GA and AV) independently appraised the studies and then compared ratings. When ratings were different, the two authors discussed until agreement was reached. Data extracted included type of study, wellbeing dimension targeted, type of intervention used (e.g. *app*, others), participants demographics, recruitment strategies and context, retention vs attrition, salient engagement elements, outcomes, and limitations and conclusions.

The emphasis of this review was not the methodological quality of the studies selected, but the characteristics of the users and their engagement with the proposed interventions (*apps*). The main intention of this assessment was to identify any salient issues that would seriously impact user engagement.

Analysis and synthesis

In the intent of capturing all data of interest, narrative synthesis was chosen as the preferred approach to evidence synthesis. The three steps of narrative synthesis, as outlined by Popay and colleagues,³⁵ were followed: (a) develop a preliminary synthesis, (b) explore relationships in the data and (c) assess the robustness of the synthesised product. To develop a preliminary synthesis of findings the data were: (a) organised into groups by type of intervention (e.g. randomised control trials [RCTs], qualitative, etc) and wellbeing dimensions targeted (e.g. physical activity, healthy eating, etc) and (b) presented in *tabular* form.

Both techniques were used in the initial stages of analysis to represent the data visually and assist the authors to identify patterns. To explore the relationships between the data, common characteristics within interventions used (e.g. recruitment, trackers, self-reporting, etc.) and participant demographics were explored using conceptual models. Finally, the methodological quality of included studies, the process of the synthesis itself and the information obtained in included studies were used to indicate the robustness of the synthesis. Having said that this review did not focus on intervention outcomes, but on participant characteristics as they related to their engagement in the different studies.

Assessing engagement

To assess engagement with the interventions (*apps*) specific comments of the original authors addressing, this phenomenon were extracted. We compared engagement specific comments with other indicators such sample characteristics, explicit incentives to participate, recruitment strategies, completion rates and real-life usability as assessed by the authors. These comments are reflected in Table 3 either paraphrased or copied verbatim for fidelity.

Results

General overview of search results and included studies

The initial data base searches yielded a total of 39,039 articles. Following the removal of duplicates, the number dropped to 11,245. The initial review stage focused on scanning articles' titles and searching for key words as established in the study selection criteria; this process excluded a further 11,017. The subsequent review of 160 abstracts identified 68 suitable studies, and after a full text assessment, 20 studies remained in the final review (refer to Figure 1). Two extra studies were identified in grey literature searches. Endnote³¹ was used as the reference management software for this review.

Ten studies were identified as RCTs, six were cross-sectional, four were cohort studies, one was qualitative and one quasi experimental. No outstanding methodological issues were identified. Out of the 22 studies selected, four wellbeing areas were identified: healthy eating (one study),³⁶ physical health (17 studies),^{37–53} mindfulness (one study)⁵⁴ and general wellbeing (three studies)^{55–57}; some studies combined these categories with other areas such as sleep and social activation.^{39,45,46,48,49,52} The types of studies are shown in Table 2 together with their objectives and conclusions. Consistent with the selection criteria, all the studies analysed used *apps* for their interventions; six also included wearable trackers.^{48,52} Eight out of 22 studies used custom designed *apps* for their interventions,^{36,38,40,46,50,55–57} while 14 used commercially

available *apps*^{37,39,41–45,47–49,51–54}; this has relevance in the context of understanding engagement as it allows comparing differences between both approaches.

Recruitment

Recruitment methods and their implications are included in Table 3. Data includes recruitment methods, study authors' comments on recruitment validity and study authors' comments on the real-life usefulness of the interventions used. These aspects have an impact in the uptake, use and retention of participants and therefore engagement. The majority of studies recruited students in both schools^{39,40,42,49} and universities^{38,41,43–46,50–57}; only five studies recruited members from the community.^{36,37,47,48,57} Several studies recruited convenience samples including researchers friends^{37,41,43,45,55,56} and existing users.^{37,43,45} Recruitment techniques included online strategies (websites), volunteers, mailing through the electoral role, inviting conscription candidates, flyers and approaching candidates directly.

Implications of the recruitment strategies described include various researchers acknowledging that their samples were not representative,^{36–38,50,53} as well as highlighting other elements impacting the sample such as participants' mood,³⁸ tool appropriateness,³⁹ the specificity of the sample (e.g. gamers),^{37,43} skewed samples such as psychology students mostly female^{43,54} and Apple-only users.⁵⁴

Participant characteristics

Most studies (18/22) reported higher female participation^{36–39,41–43,45–47,49,51–57}; this is consistent with existing literature.⁵⁵ Three studies reported mostly male^{44,48,50} (one of them focusing solely on males⁴⁸), and one study did not report on gender.⁴⁰ All the studies with mostly male participants were focused on physical health and used gamifying strategies to engage participants. As for age, all studies fit the 16–24 years of age criteria. Studies that covered age ranges beyond the specified age range were considered if their mean age was within the criteria. Participant characteristics can be found in Table 3. Few studies reported on other demographics besides age and gender, and those that did included ethnic background, socio-economic status and education. In all those cases, engagement levels and intervention effects related to those factors were not discussed or reported as nonsignificant. Five studies were completed in Europe (France,⁵⁰ Ireland,⁵³ Finland,⁴⁸ Hungary⁴⁵ and Italy⁵¹), four studies were completed in Australia and New Zealand,^{36,46,47,55} two in China^{37,42} and 11 in the United States and Canada.^{38–41,43,44,49,52,54,56,57}

Intervention types and data collection

The majority of interventions (17/22) used physical activity trackers including *apps* based on movement sensors and

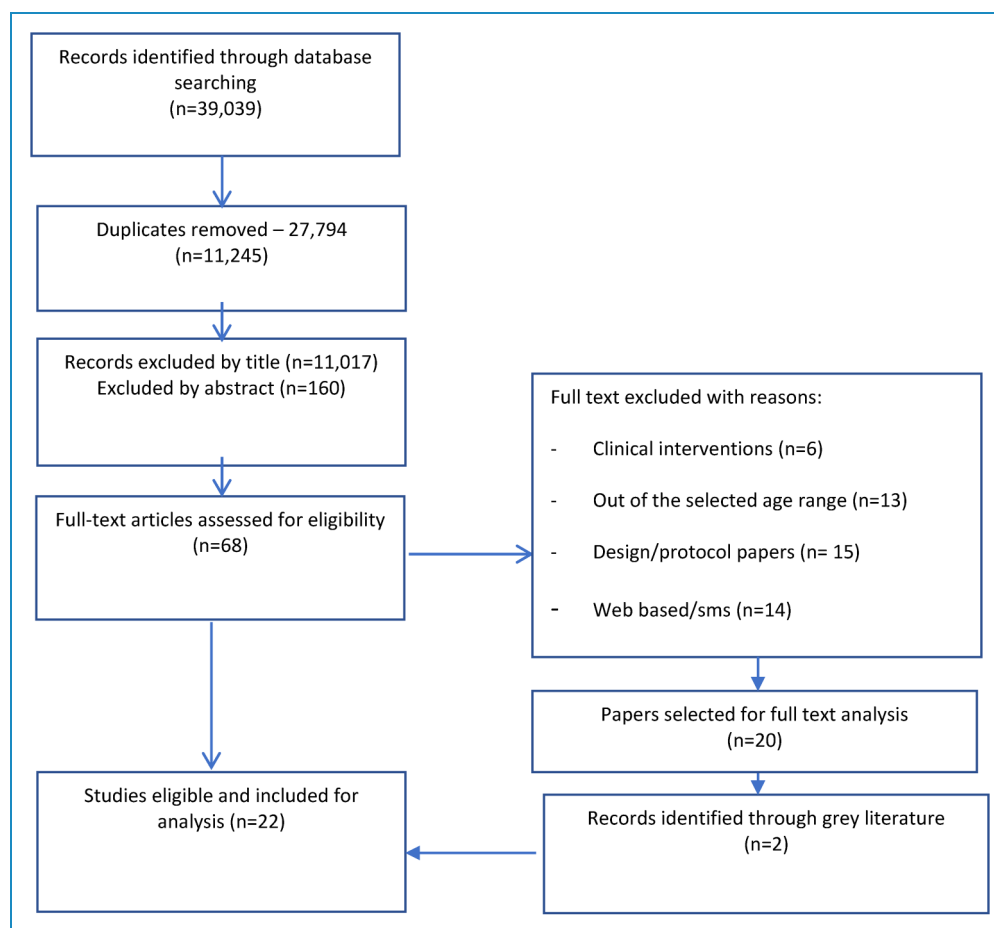


Figure 1. PRISMA flowchart.

wristbands,^{37–53} seven papers also used gamification techniques and or relied solely on games (e.g. Pokemon Go,^{37,41,44} zombies run⁴⁷ and custom games^{40,48,50}); two *apps* were designed to increase hope and positive emotion by using tailored messages.^{36,56} Seven studies relied on self-reports to track data,^{36,41,42,44,46,55,56} whereas 15 used automatic tracking in-built in the interventions.^{37–40,43,45,47–54,57}

Wellbeing areas targeted by *apps*

With the Complete State of Mental Health Model³² as a reference framework, physical wellbeing was the primary area targeted by interventions using wellbeing *apps* (17 studies). Physical activity and healthy eating constitute discreet, highly measurable categories that have a significant impact on individual wellbeing.⁵⁸ The use of pedometers and in-built positioning sensors to track physical activity is more feasible than tracking emotional, psychological or social wellbeing, as these areas are harder to quantify.^{59,60} In saying that, however, studies such as the one by Leinonen et al.⁴⁸ and the one by Demasi et al.,³⁸ targeting physical activity as their main focus did also include social, psychological and emotional variables when

discussing both engagement and outcomes. In addition, Tong et al.⁴⁶ used socialisation as a strategy to boost engagement with healthy eating *apps*.

Clear attempts have been made to develop *apps* to impact emotional, psychological and social wellbeing (e.g. Vella et al.⁶¹ or Carey et al.⁵⁵). Studies targeting these areas often relied on specific psychological approaches that have a consistent evidence base in clinical settings, for example, Cognitive Behavioural Therapy or Acceptance and Commitment Therapy. These approaches are systematic in nature and lend themselves to being codified in *apps* to be applied remotely. A number of clinical studies support the efficacy of these approaches in mHealth.^{62,63}

Only two studies defined wellbeing in the context of PP.^{55,56} One study defined wellbeing as an improvement on current deficits.³⁸ The remaining studies did not define wellbeing as a specific category, focusing instead in discreet behaviours such as physical activity or healthy eating.

Attrition and engagement incentives

Following standard practice⁶⁴ studies reporting attrition levels over 20% were considered high. Two studies did

Table 2. Main characteristics of included studies.

Article	Year	country	Objective	Wellbeing dimensions	Study type	intervention-commercial or commercial	Conflict of interest	Type of tracking	Study length
1	2019	CHI	To assess the health impact of augmented reality games by examining the association between PokemonGo and physical activity among university students	Physical activity	Cohort – pilot	Commercial	No	Automatic	1 week
2	2017	US	Assess the extent to which activity and sleep tracking with a smartphone can be used for monitoring individuals' mental well-being.	Physical activity and sleep	Cohort	Custom	No	Automatic – self-reported	8 weeks
3	2020	USA	This paper explores if adolescents' inclination towards particular exercise motives influences their commitment to the sustained use of a wearable device (Fitbit)	Physical activity	Cohort	Commercial	No	Automatic	3 months
4	2013	CAN	Test an initial mobile fitness prototype's efficacy in generating positive attitudinal changes towards fitness activity using strong socialisation components within the game	Physical activity	Cohort – pilot	Custom	No	Automatic	6 weeks
5	2017	US	Assess self-reported walking and sedentary behaviour before and after downloading 'Pokemon Go'	Physical activity	Cross-sectional	Commercial	No	Self-assessed reporting	3 weeks
6	2020	CHI	Exploration of the psychological mechanisms that determine college students' continuance intention to use fitness apps	Physical activity	Cross-sectional/mixed methods/semi-structured interviews	commercial	No	Self-reported	N/A
7	2016	AUS	The aim of the pilot study was to assess the usability and acceptability of receiving MOL-style questions via intermittent daily text messages	Wellbeing	Cross-sectional	Custom	No	Self-reported	1 week
8	2020	USA	To explore which features of wearable trackers are used and deemed helpful	Physical activity	Cross-sectional	Commercial	No	Automatic	N/A
9	2020	USA	To compare whether physical activity participation between Pokemon Go players is different than that of non-users	Physical activity	Cross-sectional	Commercial	No	Self-reported	N/A

(continued)

Table 2. Continued.

Article	Year	Country	Objective	Wellbeing dimensions	Study type	Intervention-custom or commercial	Conflict of interest	Type of tracking	Study length
10	2019	Hungary, Slovakia	To understand wearable activity trackers among university students	Physical activity/sleep	Cross-sectional/focus groups	Commercial	No	Automatic	N/A
11	2018	AUS	Understand users' perspectives regarding mobile social networking intervention to promote physical activity	Physical activity	Qualitative	Custom	Potential benefit from app (fit.healthy.me)	Self-reported	6 months
12	2018	US	Test the feasibility of using EMI's via an app and their effect on EWB and HWB	Wellbeing	Quasi-experimental	Custom	No	Response to app messages	28 days
13	2015	NZ	To determine the effects of two commercially available smartphone apps (Zombies, Run and Get Running) on cardiorespiratory fitness and PA levels in insufficiently active healthy young people. Identify the features of the app design that may contribute to improved fitness and PA levels	Physical activity	RCT	Commercial	No	Automatic	8 weeks + follow-up
14	2017	FIN	Study the feasibility of an automated, gamified, tailored Web-based mobile service aimed at physical and social activation among young men	Physical and social activation	RCT	Commercial	No	Automatic – wrist-worn physical activity monitor	6 months
15	2018	US	This study examined the effects of utilising a wearable activity tracker for promoting physical activity (PA) in college students. in a credit-based physical activity instructional program (PAIP)	Physical activity	RCT	Commercial	1 author worked for Polar Electro	Automatic – misfit flash activity tracker	15 weeks
16	2016	AUS	Improve nutrition behaviours using a mobile food record and text messaging	Eating behaviour/weight loss	RCT	Custom	No	Self-reported and sms	6 months
17	2017	FR	Evaluate the effects of an exercise bike video game played by using exergame designed exclusively to promote participants mvpa	Physical activity – bike cycling	RCT	Custom	No	Automatic	1–15min session + questionnaires
18	2018	ITA	Effectiveness of mobile fitness apps in changing	Physical	RCT	Commercial	No	Automatic/self-reported	1 semester

(continued)

Table 2. Continued.

Article	Year country	Objective	Wellbeing dimensions	Study type	intervention- custom or commercial	Conflict of interest	Type of tracking	Study length
19	2018 – US	people's attitudes toward physical activities to pursue health improvement Evaluate the feasibility of combining a smartwach with social media for delivering health education	activity – walking Physical activity and diet	RCT – pilot	Commercial	No	Automatic – watch	12 weeks
20	2016 – IRE	Determine the efficacy of the Accupedo-Pro Pedometer mobile phone app intervention for increasing daily step counts in young adults	Physical activity	RCT – pilot	Commercial	No	Automatic – pedometer	5 weeks
21	2017 – US	Testing the effects of a simple and complex version of a novel app using the ACT matrix in two distinct samples	Wellbeing	RCT – pilot	Custom	No	Automatic – self-reported	4 weeks
22	2019 – CAN - SWT	Investigate a newly developed MT app called Wildflowers, which was codeveloped with the laboratory for use in mindfulness research	Mindfulness	RCT	Custom/commercial	Two authors*	Automatic	3 weeks

*One author is the Chief Scientist and CEO of Mobio Interactive Inc, but worked only as a technical liaison. He did not contribute to study design methodology. A second author is a scientific advisor and mindfulness guide for Mobio Interactive Inc; this author was involved in all aspects of study design and data analysis, but did not directly contribute to, or have influence over, data collection; nor did he directly perform any of the analyses.

Table 3. Recruitment and engagement.

Paper	Recruitment	N	Age	Gender	Recruitment validity (author's comments)	Incentives – engagement elements	Realistic intervention in terms of everyday use (authors' comments)	Engagement (authors' comments)
1	Convenience sample of medical students from the University of Hong Kong	65	20.7	F – 65%	Sample is not representative. Findings may be a reflection of specific characteristics of the participants: Gamers. Participants were already Pokemon Go players at the time of recruitment	Exergame	Authors conclude that the use of exergames can improve the levels of physical activity more than usual interventions.	High uptake initially but low engagement and low effects after Week 1. Repetitive nature of the game leads to loss of interest
2	Participants from the university community through the Experimental Social Science Laboratory (XLab) (University of California)	106	20.32 (2.5)	F – 55.3%	Small sample size. Participant's mood, depressed participants are less likely to be active. Participants' self-reported well-being is subjective.	None mentioned	Authors conclude that using smartphone's accelerometers can contribute to tracking individual's wellbeing.	Participants did not engage fully due to the highly prescribed nature of the intervention. More work is needed to tailor mood and depression tracking apps to individuals; attrition was high.
3	High school students were recruited. Participation was voluntary	59	16–18	38F – 21M	Authors comment on the validity of the tool used to detect motivational factors as not being fully appropriate for this population.	Students could keep the 'fibtits'	Authors discuss participants motives to use wearables, and assume that they are a legitimate intervention tool.	Participants used fibtits as a medium to stay healthy and thus keep current in their social interactions. Stress management, revitalisation, ill-health avoidance, positive health and weight management were considered as engagement elements 'adolescents want to participate in life', exercise is a mechanism to stay healthy.
4	High school students. No details were given about the recruitment process	12	15–17	Nonreported	Authors noticed that socially inclined participants were more likely to benefit from the intervention. No comments about recruitment.	All from the same school	Authors comment on the positive changes brought about by the intervention. Socially inclined subjects use the social features of the application as they use the application exercises.	Fun, enjoyment and social inclination are individual factors pointing to personal preferences (identity). Exergaming implies the element of 'fun', the social dimension is also highlighted; the study makes reference to 'socially inclined' participants as most likely to benefit from the intervention.
5	University students – random	358	19.8 + / – 2.1	F – 52.2%	Authors recognise Pokemon Go and GPS enhanced games as viable ways of	Existing users	Authors conclude that 'Pokemon Go' is	Highlighting enjoyment and interest in a particular type of participants

(continued)

Table 3. Continued.

Paper	Recruitment	N	Age	Gender	Recruitment validity (author's comments)	Incentives - engagement elements	Realistic intervention in terms of everyday use (authors' comments)	Engagement (authors' comments)
	convenience sample, recruited by research members				improving physical activity. No comments about engagement.		associated with higher walking and less sedentary activity.	a.k.a gamers, or people with a predisposition for 'Pokemon Go' (identity)/ novelty and fun, joining the enjoyment elements of technology and the outdoors and appealing to 'certain individuals'. Most 'Pokemon Go' engaged users most likely had downloaded the app previous to the study.
6	College students - no description about recruitment processes	379 / 10	23-23.4	Stage 1: F - 69.9% 2: 7F-3M	The authors did not comment of recruitment strategies. The study group is composed of college students who are more tech-savvy and proficient at using new technology, which limits the generalisation of the findings.	Chinese college students who are already using fitness apps	Apps can be useful as long as they feel convenient to use and should be efficient. Strong credibility with negligible effort.	Usefulness, ease of use, satisfaction, fitness achievement and social connection. Goal-oriented behaviour and personal interest prime over app design/ confirmed usefulness, confirmed ease of use, satisfaction, fitness achievement and social connection). Enjoyment was dismissed as users will keep engaged as long as they have a clear personal goal (health).
7	Self-selected, convenience sample recruited through an online volunteering database at the University of Manchester and in person by the second author	23	18 +	F - 86.9%	Authors acknowledge that the majority of participants were psychology students who are predominantly female.	£5 was offered to participants upon completion of the 2-week data collection period.	The results of this pilot study indicate that MindSurf will be an acceptable and usable app that does not appear to generate adverse events.	Personal reflection and self-awareness point directly to personal/ individual motivations/users reflected on patterns of thought and behaviour, which may play a general role in their wellbeing. This was considered as a reason for engagement with the intervention.

(continued)

Table 3. Continued.

Paper	Recruitment	N	Age	Gender	Recruitment validity (author's comments)	Incentives – engagement elements	Realistic intervention in terms of everyday use (authors' comments)	Engagement (authors' comments)
8	Recruited via physical flyers with a QR code to access the survey, presentations in student organisations, university email, and social media postings (e.g. Instagram, Snapchat, Facebook). A convenient sample of wearable owners attending or worked at the university, or were friends of research team	47	18–24	F – 80.9%	Researchers believe that the data collected goes into explaining motivational cures and health information. No comments about recruitment	Nonmentioned	Researchers affirm that the sample is similar to the general population who use wearable fitness devices, mostly young overweight female.	The study comments directly about differences regarding users' individual characteristics (gender, ethnicity, personal goals and others) and engagement with the intervention, however results are inconclusive regarding characteristics and predisposition to explain usage and engagement with wearable fitness. The primary focus is on the user and not necessarily in the intervention itself.
9	College students recruited with campus flyers, class visits, word of mouth	393	19.03 (2.04)	F175/393	The authors acknowledge that the study only focused on college population.	Nonmentioned	Most users agreed that playing the game had a positive impact. The authors conclude that health practitioners may use this game to promote youth and young adults walking and/or jogging behaviours, with setting specific goals.	The differences found in this study reference personal characteristics and individual perceptions and explanatory for engagement and outcomes/participants in the intervention arm walked less than those in the control group. However, they perceived Pokémon Go as useful, fun and motivating to exercise. This difference in effects and perception may be due to users' characteristics (usually gamers are more sedentary).

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Table 3. Continued.

Paper	Recruitment	N	Age	Gender	Recruitment validity (author's comments)	Incentives – engagement elements	Realistic intervention in terms of everyday use (authors' comments)	Engagement (authors' comments)
10	Participants were selected from among the population of the university in general education courses. For in-depth interviews, potential participants were approached and verbally recruited by authors	400	20.55	F – 56.8% ; F – 54%	-	Current users	Wearable devices have positive effects on physical activity among university students.	As a general rule the constant wearing of the device is influenced by aesthetic and comfort. Fashionable to wear. Self-monitoring and goal setting and inherently personal characteristics. Social comparison has shown efficacy in particular contexts. Self-monitoring, goal setting and social comparison were considered, however results are inconclusive regarding engagement.
11	University staff and students – purposive sampling techniques (posters, website, social media, email, newsletter)	55	23.6 (4.6)	F – 51%	Researchers acknowledge the small sample size and that it may not reflect the experience of other groups	Nonmentioned	Self-regulatory BCTs seem to be necessary – social comparison, existing social ties and homophily are important. offer goal setting, self-monitoring and feedback as a bundle.	Self-regulatory behaviour change techniques as necessary for engagement as well as social. Self-regulation techniques and social factor: individual (self-monitoring of behaviour, goal setting, and feedback on behaviour), social (social comparison, similarity and familiarity between users and participations from others in the network. Technological limitations are considered to be a barrier for engagement. Important factors: existing social ties and homophily. It clearly emphasises personalized interventions.

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Table 3. Continued.

Paper	Recruitment	N	Age	Gender	Recruitment validity (author's comments)	Incentives – engagement elements	Realistic intervention in terms of everyday use (authors' comments)	Engagement (authors' comments)
12	Convenience sample of residential undergraduate volunteers drawn from behavioural science classes at Indiana Wesleyan University	112	18–25	F – 70.5%	-	Extra credit + volunteers in the research database	Mobile app-based EMIs may provide a feasible means of fostering hope in the moments of daily life.	Hope was framed as a personal element and as such the results are open to interpretation. It is not clear what could have driven engagement in the intervention group; the non-users group did not engage with the app and it is unclear what would have caused the changes in hope. The study alludes at the religious context of the institution where it was implemented.
13	Participants were recruited through advertisements in electronic mailing lists, local newspapers, flyers posted in community locations and presentations at schools	51	14–17	F – 57%, M – 43%	High retention rate. Further, using paid apps instead of free ones has likely reduced the chances of contamination and/or cointerventions.	Apps were free of charge to participants after trial completion. Follow-up participants received a NZ \$10 gift card to a local shopping centre for each visit to complete study measures (i.e. maximum NZ \$30 for 3 visits).	Self-regulatory techniques and social factors are important to consider when designing a physical activity intervention, but a one-size-fits-all approach is unlikely to satisfy different users' preferences.	Use of monetary rewards-gamification/immersion, leisure and experience are considered important for engagement with exergames. The study emphasises the need for personalised interventions.
14	All conscription-aged men (n = 1265) living in a small town were invited to participate in the 6-month trial	496	17.8 (0.6)	M – 100%	Authors point out that attrition using wearables is a common phenomenon in research. No comments about recruitment validity.	Gamification	To motivate those who are not interested in physical activity but might still benefit from physical activity information and guidance, more persuasive and behaviour change-supporting intelligence should be implemented.	This study considers the importance of functionality. Mobile service users considered the various functionalities related to physical activity important. However, compliance of the service was limited.
15	Two-stage sampling method to recruit participants. In the first stage, a total of 14 classes were randomly selected, out of 20 eligible courses, and randomly assigned to either intervention or control groups, with a 1:1 allocation ratio. In the second stage, a gender-stratified random	187	20 (1.75)	F – 67%	No comments about recruitment validity.	College context	This study found no effects of utilising the wearable activity tracker in promoting PA in college students.	Engagement cannot be mandated, it responds to individual preferences and motivations/this study reports low engagement, they attribute this to the impossibility to enforce and/or motivate users externally. It recognises the need to pay

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Table 3. Continued.

Paper	Recruitment	N	Age	Gender	Recruitment validity (author's comments)	Incentives – engagement elements	Realistic intervention in terms of everyday use (authors' comments)	Engagement (authors' comments)
	sampling was used to recruit approximately 60% of students ($n \approx 18$) within each course.							attention to individual differences (satisfaction, motivation, etc).
16	Young adults aged 18–30 years were recruited from the Federal Electoral Roll. They were selected from 57 suburbs within the Perth metropolitan area to provide representation across socio-economic status. Other recruitment methods supplemented the mail out and included advertising on the university website, flyers posted on campus and referrals from friends or colleagues	247	24.3 (3.4)	F – 68%	Researchers point out that the responders may not have been representative of the population. The response rate from women was higher than men. However, the participants recruited were from a diverse background for socio-economic status and ethnicity.	All participants received a \$20 gift voucher of their choice at baseline and six months and were entered into a prize draw to win an iPad, iPod or shopping voucher at the end of the study.	Smartphone-based groups can promote fruit and vegetable consumption and decrease unhealthy snack intake.	This study registered differences in the engagement levels of women (higher) vs men (lower). The engagement differences between genders speaks to identity and motivation factors. Also, the study hypothesis was that the more intensive intervention with greater contact points would be more effective, but this was not the case.
17	Participants in the study were a convenience sample of 163 undergraduate students recruited from the sport science department of a French university located in the northwest region of France	163	20.31 (1.30)	M – 61.3%	Researchers acknowledge that participants were young adult college students recruited from a department of sport science.	All of the same school	A newly designed mobile application-based exergame played via an exercise bike may enhance situational interest and provide a decent level of PA for players.	Interest is dependent on enjoyment, exploration and attention demand were considered essential for engagement. In order for attention and enjoyment to occur, participants need to be motivated. Situational interest.
18	Students from the University of Milan were contacted during class and took part as volunteers in the study	78	19.94 (1.36)	F – 88.5	No comments about recruitment validity.	Not specified	The present study provides encouraging evidence for the positive effects of using a fitness-tracking app in promoting health behaviour.	Fitness apps can influence health behaviour. Intentions, attitudes and norms are mediated by personal motivation, goals and values. This is expressed in perceived behavioural control. Intentions are influenced by attitudes and norms.
19	Thirty-eight college students from a large metropolitan Midwest University were recruited via flyer/email	38	21.5 (3.4)	F – 73.6%	No comments about recruitment validity.	Participants were paid \$30 for successful study completion (i.e. all data	While both arms demonstrated initial efficacy in improving CS health outcomes, observations did not	This study captured comments on users' preferences for some design features over others. Comments on

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Table 3. Continued.

Paper	Recruitment	N	Age	Gender	Recruitment validity (author's comments)	Incentives – engagement elements	Realistic intervention in terms of everyday use (authors' comments)	Engagement (authors' comments)
	communication and in-person recruitment presentations					collection sessions completed and study devices returned	indicate the experimental intervention as more efficacious than comparison.	engagement refer to persuasive design and usability.
20	Students recruited through the university's research participation website	58	20.5	F – 74%	This study acknowledges: (a) self-selection of the sample, (b) limited generalisability of results (given the focus on college students), (c) short follow-up timeline, and (d) use of an active control group.	Extra credit + volunteers in the research database	The results of this study demonstrate that a mobile phone app can significantly increase physical activity in a young adult sample by setting specific goals, using self-monitoring, and feedback.	This study comments that a one-size-fits-all approach is not enough to sustain engagement. This study recommends tailoring interventions to the individual level of activity and to include psychosocial factors: motivation or self-efficacy.
21	Two recruitment routes were used: advertising the study to university students (Sample 1, $n = 63$) and directing adults from the community interested in self-help (Sample 2, $n = 35$)	63 and 35	24.57 (7.86) and 20.24 (3.88)	F – 65.7%/F – 73%	This study acknowledges the size of the help-seeking sample being relatively small. Also, the contact of researchers and users made it to be less naturalistic. Both samples were young and ethnically homogeneous.	Academic credit for university cohort	Improvements in the help-seeking sample were primarily driven by the version of the app with additional features, suggesting that the perceived credibility of an app may be higher when it includes a variety of additional features. Finally, adherence was relatively low, which suggests that it may be helpful to include additional features.	This study shows the importance of personal motivation and readiness as the main factor influencing engagement and outcomes. Higher improvements (higher engagement) was found in the help-seeking cohort in contrast to the incentivised cohort, even though help seekers used the app less. This point to motivation and readiness to make changes at a personal level.
22	University students, recruited via the undergraduate recruitment site and via flyers	41 and 45	19.78 (2.43) and 20.24 (2.63)	F – 88%, M – 12%; F – 80%, M – 20%	Researchers acknowledge that the sample was limited to participants with Apple devices. The study had a female-dominated sample.	Course credit if recruited via the undergrad recruitment site and \$10 p/h for students recruited via flyers max \$90	Mindfulness training using a smartphone app, may provide immediate effects on mood and stress while also providing long-term benefits for attentional control.	Personal disposition and reflective awareness are considered as the main drivers for engagement and efficacy of wellbeing interventions/dispositional acceptance is related to reduced experiential avoidance, self-awareness in the form of recording mood and stress levels may improve engagement.

not report attrition results, one that had high participant participation⁵⁰ and the other being a prototype with only 12 participants⁴⁰; all cross-sectional studies ($n=6$) were based on surveys, and therefore, attrition was not considered.^{41–45, 55} Different engagement incentives were used to recruit and maintain participants active involvement in the studies analysed. In the context of this review, these incentives can be classified in three types: common practice, context related and *app* related. Common practice engagement incentives refer to strategies regularly used in research studies, and these include social rewards, small economic incentives and the use of gifts. Four studies offered economic rewards varying from \$30 to \$90 for participating in interviews.^{36,47,52,54} Gifts were also utilised with one study giving away fitbits.³⁹ Social rewards were related to being part of the same social group and to cohorts belonging to the same discreet social context (e.g. schools); this was observed in three studies. Context-related incentives refer to using participation in research as a condition to meet a larger obligation; this was the case of using academic credits and defining research as an assessable component for a particular course.^{53,56,57} Three studies used strategies like gamification, situational interest, enjoyment, convenience and enhanced awareness.^{38,46,47} These were highlighted as *app*-specific features driving engagement. Lastly, three studies recruited participants who were described as existing users.^{41,42,45}

Five studies reported high attrition,^{38,48,49,56,57} two of them used university students without a clear indication of their motivation to participate,^{38,49} and one of them used the intervention as part of a university course.⁵⁷ One of the studies in this group lasted for six months; it recruited only males in a highly context-specific setting (military call-out cohort in Finland) and despite using high gamification techniques still reported high attrition.⁴⁸ Although two studies used extra university credits and worked with volunteers, engagement was still low.^{38,57}

One study reported a mid-range attrition level between 10% and 20%.³⁶ This study reported predominantly female participants in the older end of the spectrum ($M=24$ years of age), lasted 6 months, and paid participants \$20 for their contribution. This study focused on healthy eating and used self-report requiring participants to actively communicate with researchers and used self-report.

Nine studies demonstrated high retention with attrition levels of under 10%.^{37,39,46,47,51–55} Two themes stand out to explain engagement in these studies, the first one being high reward plus short duration, opposite to long studies with little incentive. In this review, examples of high reward/compensation given to participants were: keeping the fitbits³⁹; incentives of \$10–\$90 per interview (sometimes for multiple interviews)^{47,52,54}; and granting academic credit.⁵³ Most of these studies were short lasting no more than eight weeks.^{37,47,53–55} The second theme was seamless intervention and low contact, opposite to intense interaction or overwhelming demands from the

apps themselves. All the studies in this category were designed as low interaction interventions; the demand from participants in these studies was minimal. Automatic tracking was the privileged modality to collect data,^{37,39,47,51–54} only two of these studies also used self-report as part of the intervention.^{46,55} In the studies using automatic tracking researchers used in-built *app* features that allowed participants to ‘forget’ about the *app*, which kept gathering data as long as the mobile was on. This seamless tracking is also part of accelerometer-based pedometers such as the Actigraph GT1M.⁴⁷ Studies in this category also used intense gamification techniques and commercial *apps*: zombies run vs cto5k,⁴⁷ Actigraph accelerometer and the accupedo-pro pedometer *app*.⁵³

Engagement

According to the studies analysed, participants engagement with *apps* can be related to identity factors that transcend the *apps* themselves; these were context specific, socially driven and personalised. Examples of context specific and socially driven elements included participants belonging to a very specific setting (e.g. same social circle)⁴⁶ or accessing the study with pre-existing motivation⁵⁰; some studies in this category recruited participants enrolled in specific courses such as sport science or IT.³⁸ Social comparison seems to be a driver for engagement, with elements as homophily and existing social ties named as highlights.⁴⁶ Elements such as fun and social inclination are pointed as essential engagement elements,⁴⁰ at the same time these factors are linked with individual preferences. Similarly usefulness, satisfaction and social connection are important for authors⁴² who in turn dismiss the fun factor in favour of participants having a clear personal goal. Other elements such as health perception were seen as mediators to higher goals, as Deranek et al.³⁹ states: ‘*adolescents want to participate in life*’ (i.e. keep social connections, avoid stress and revitalisation) and see exercise as a mechanism to stay healthy to achieve this.

Personalised, innovative and contextualised *apps* had better positive engagement comments than simpler themed *apps* without a back story (e.g. pedometers).⁴⁷ Gamification was used as a privileged strategy and included elements such as: situational interest, enjoyment, convenience and enhanced awareness. These were highlighted by researchers as *app*-specific features driving engagement. Studies such as those analysing Pokemon Go^{37,41,44} relied on personal identification elements that surpassed the *apps* themselves, highlighting personal characteristics and preferences by identifying most users as ‘gamers’ or as having a natural proclivity for these type of interventions.⁴¹ Most participants in these studies had already downloaded the *app* before the study. However, these studies also showed high uptake initially with a quick loss of interest after the first week, and authors attribute this to the repetitive nature of the game.³⁷

The possibility of setting personal goals was found to be preferable than having the *app* set up in a fixed way.³⁸ It was also noted that participants in these studies were mostly in the younger end of the age spectrum analysed, with most of them being under 20 years of age.

Identity

Almost all studies in this review emphasised the need to consider individual characteristics and preferences to explain and enhance engagement with health *apps*. This was true with respect to the perception of hope⁵⁶ as well as for participants understanding of wellbeing.⁵⁵ In this context, personal reflection and self-awareness were considered as a reason for engagement with the intervention, and these are specific individual elements.

Making the user the primary focus, understanding their personal characteristics, instead of the intervention itself was recommended.^{38,41–44,46,47,49,51,53–55,57} Similarly, motivation understood as an individual factor was recognised as a primary factor for engagement when comparing men and women in a study looking to improve eating behaviours.³⁶ Consistent with this, situational interest derived from individual motivation⁵⁰ was related to enjoyment, exploration and attentional focus. Personal attitudes, norms, motivation, goals and values can be expressed in perceived behavioural control.⁵¹ An example of this is that in the study by Krafft et al.⁵⁷ where better outcomes were found in the help-seeking cohort (those that did not get any incentives to participate vs. the incentivised cohort that got academic credit). In a similar way Walsh et al.⁵³ recognised that personal disposition and reflective awareness are considered as the main drivers for engagement. There seems to be agreement that one-size-fits-all approach is not enough to sustain engagement and that tailoring interventions to the individual could improve meaningful engagement with these interventions.^{38,41–44,46,47,49,51,53–55,57}

Design, usability, functionality and features

Several studies mentioned design and usability factors as mediators for engagement, elements such as aesthetic, comfort and functionality^{45,48}; however, they still linked these factors with personal preferences and perceptions such as wearables being ‘fashionable’. Usability was also related to specific features and behaviour change techniques. Some of these included self-monitoring and goal setting, self-monitoring of behaviour, and feedback on behaviour. Technological limitations are considered to be a barrier for engagement comparison.⁴⁶

Discussion

The current systematic review of the literature and narrative synthesis set out to investigate the connection between users’ characteristics and level of engagement in

interventions using mobile *apps* to increase and support wellbeing. It was found that most studies do not reflect on engagement beyond retention for the duration of the intervention, so therefore there was not a clear definition of what engagement is and how it impacted results. Having said that, most studies commented on the enablers and the limitations of their interventions, their uptake and participants’ perceptions. In that context, we analysed all the comments related to engagement and included factors such as recruitment strategies, sample characteristics and authors perception of usefulness of their interventions in real life contexts.

It was found that most studies recruited university students, which is in line with regular university recruitment strategies; although this could be seen as a sampling bias, the context of this study is expected that young people would be mostly students given the age ranges. Recruiting from a very specific context can potentially impact engagement due to affinity, peer pressure or institutional expectations; most studies used convenience samples, often times small and also highly contextualised; only men in the process of conscription, or high concentration of females studying psychology, members of the same class in the same school, existing users of the technologies investigated, IT students testing an *app*³⁸; members of the same social group/class⁴⁶; or pre-existing users.⁴⁵ While most studies reported demographic characteristics in varying levels of detail, they did not comment in a meaningful way regarding engagement results to any of these demographic indicators.

A clear example of using identity elements to engage participants is ‘Pokemon Go’. The ‘Pokemon Go’⁶⁵ phenomenon started in 2016 and exploded throughout the world with thousands of people downloading and playing the most successful ‘exergame’ to date.⁶⁶ Our review analysed three studies focusing on ‘Pokemon Go’.^{37,41,44} Researchers in these three studies highlight the personal characteristics of participants: ‘gamers’ and existing users, indicating that users of this *app* are intrinsically motivated. There is agreement that ‘Pokemon Go’ has significantly increased physical activity for players. Undoubtedly this had many positive effects including improvement in physical and mental health, socialisation and emotional wellbeing⁶⁷ even though the effect has proved to be of short duration, as studies report decrease of activity after five to six weeks of using the game.⁶⁸ However, by using identity strategies ‘Pokemon Go’ speaks to a generation in the same way ‘Star Wars’ or ‘Harry Potter’ would, it appeals to nostalgia, creates a sub-culture and boosts sense of belonging. As Howe et al.⁶⁸ report, the uptake of ‘Pokemon Go’ went beyond ‘sex, age, race group, bodyweight status, urbanity, or walkability of the area of residence’, effectively engaging participants at a higher level of identification. This game is also a great example on using personalisation features, using different challenges, difficulty levels and

sense of achievement; all of this on top of using enhanced reality to integrate the game with the participants' own environment. Persuasive design elements were also mentioned by some studies, usability and functionality are at the top of the list; however, elements such as aesthetic and being 'fashionable' still play an important role in users' adoption and reflect personal preferences based on identity.

In the context of *app* development, establishing the identity elements that would attract participants to engage with the concept that needs to be communicated (i.e. wellbeing) is suggested to be more important than the actual technical design.

Most studies in this review focused on the interventions as the first step of the process instead of starting with the individuals and their needs; this points to the need of implementing design strategies based on participatory research methodologies to allow users to be involved in the process from its inception.²⁸ Having said that, it is not clear if successful apps such as 'Pokemon Go' do use these design methodologies. In any case, the findings of this review point to the fact that real engagement does not happen unless participants have a personal intrinsic motivation; this is usually either due to the need to satisfy a deficit as it happens in clinical studies or due to having a vested interest such as 'having to do it' to satisfy a larger need (e.g. a study course). Several studies in this research hint to the need to consider the individual and their particular characteristics as the starting point to plan and design wellbeing interventions.

Various researchers in the studies analysed in this synthesis noted how elements such as failing to address individual preferences can affect perceived autonomy and personal interest when engaging with wellbeing *apps*.⁴⁹ Similarly, some mentioned how merely using a wellbeing *app* without having a personal motivation and self-awareness of the importance of a healthy lifestyle hinders any expected positive outcomes.⁵¹ Boosting personal preferences when designing wellbeing interventions can increase their effect.⁴⁰ Games can approach audiences using different identification elements that become more or less accepted in the degree in which users identify with them.⁶⁹ These same principles could be applied to the design of mobile *apps* that although being broader in their approach still hold some features that can be personalised and sequentialised almost in a gamified way.

The current study highlights the need to properly understand who the audience is before implementing features or behaviour change interventions in *app* design. The directionality of research in mHealth should emphasise the individual not only as the intervention recipient, but primarily as its originator. This review suggested that *apps* relying on clear identity driven elements are more likely to produce high levels of engagement and arguably therefore to be more effective at their intended goals, in turn

highlighting the need for and importance of effective participatory research strategies in the design mHealth interventions.

Finally, the paucity on understanding the concept of wellbeing is telling with regards to developing effective interventions, and it is clear that most research is still focused on a deficit driven rather than strength-based approach. At the same time, this constitutes an opportunity for new developments aimed at creating positive mental health, boosting wellbeing at population levels and educating young people on the importance of maintaining and creating a culture that seeks flourishing as an ideal and not only the absence of illness.

Limitations and strengths

The aim of this review was to start a reflective process with regards to delimiting an area of research: engagement with wellbeing interventions in the context of mHealth, and propose themes for design and focus of interventions for future research. As knowledge in this area is constantly changing at an ever-increasing speed, together with the difficulty in conceptualising wellbeing in the context of mHealth, this may have caused some key articles to be missed. However, every effort was made to identify all possible articles, including a review of grey literature. Often studies focused on reporting primary outcomes and overlooked the leading factors in the research process; therefore, the lack of consistency in articles reporting high-quality data is recognised as a limitation, for example, demographics (including gender diversity), attrition rates and particularly engagement. In that context, the lack of a clear definition for engagement derived from the literature clearly impacts any efforts to investigate this using this type of review. That said, a strength of this review was capturing data within a broad scope, not limiting itself to just one aspect of wellbeing or one type of intervention. Accordingly, this approach contributes by finding common grounds of interaction for research designed with different variables in the context of wellbeing theory. We consider focusing on wellbeing and not in deficit driven clinical interventions as a strength; although wellbeing and PP interventions are used and researched consistently, effectively translating their techniques and content in mHealth interventions is still a challenge and a new direction with clear benefits for the future.

Conclusions

Young people are characterised by peak performance in health and intellectual capacity as well as forming strong social networks, identity and productivity. Wellbeing *apps* targeting young people have the potential to make a targeted and sustained difference at a critical stage of life and are rapidly becoming the privileged way to achieve

this. The current results suggest that effective engagement with wellbeing *apps* happens when their design and content include identity elements that transcend the *apps* themselves and allow users to access personal customisation, in line with their sense of achievement, challenges, motivation, mood, values and rewards. Understanding who young people are, what are their motivations, how they look at themselves and how they codify their world appears to be the key to effectively shape and apply engagement strategies with long-term impact. However, having and communicating a shared understanding of wellbeing and involving all actors in the creation of this and associated *apps* to promote wellbeing remain a challenge.

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