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Mental health related outcomes across repeated testing of a co-designed preventative mental health smartphone app for University students

Melinda McCabe, Michelle Byrne, Judith Gullifer, Isabelle Smart, Chunlei Chang, Sanket Singh, Gagan Khara, Kim Cornish

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Abstract

Background: Health and mental health digital tools have emerged as a promising and necessary future of healthcare in a post-COVID 19 pandemic era. In the preventative mental health space many smartphone apps and digital tools available have either limited empirical or research support, or are limited in their ability to design to a commercial standard using iterative development methods.

Objective: The current study explored the mental health and help seeking related outcomes of the iterative testing of the Monash Thrive app. It was hypothesised that there would be an improvement in all outcomes across both trials (1), and that these improvements would be observed to a greater degree in trial 2 compared to trial 1 (2).

Methods: The Monash Thrive app was tested across two iterative trials in 2022, the minimum viable product (MVP) of the app was tested across 4 weeks of use, followed by the beta version of the app (redeveloped based on MVP testing feedback), tested across 12 weeks of use later that year. Mental health variables including anxiety, depression, mental health literacy and help seeking intentions were compared at pre and post app use for each trial.

Results: Improvements in mental health literacy, anxiety and help seeking intentions towards smartphone apps improved in trial 1, changes in all other variables were insignificant. Trial 2 did not demonstrate any significant changes across all variables of interest.

Conclusions: The initial hypothesis was partially supported by findings, the second hypothesis was not supported. The absence of observed worsening of all variables of interest across time are a promising observation given the timing of each trial during teaching semesters. The lack of predicted improvement in mental health outcomes in the second trial compared to the first highlights the importance of iterative design and testing where changes may not always result in measurable improvements. Clinical Trial: Two trials were included in the current manuscript. Trial 1 was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12622001054707). Trial 2 was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12623000131651).

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Mental health related outcomes across repeated testing of a co-designed preventative mental health smartphone app for University students

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Keywords: Mental Health; Prevention; Smartphone App; Digital Tool; University Student; Wellbeing; Stigma; Help Seeking; Anxiety; Depression

Abstract (450 words)
Background: Health and mental health digital tools have emerged as a promising and necessary future of healthcare in a post-COVID 19 pandemic era. In the preventative mental health space many smartphone apps and digital tools available have either limited empirical or research support, or are limited in their ability to design to a commercial standard using iterative development methods.
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Results: Improvements in mental health literacy, anxiety and help seeking intentions towards smartphone apps improved in trial 1, changes in all other variables were insignificant. Trial 2 did not demonstrate any significant changes across all variables of interest.
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Trial Registration:
Two trials were included in the current manuscript. Trial 1 was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12622001054707). Trial 2 was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12623000131651).

Introduction:
The devastating global impact of the COVID-19 pandemic has led to an exponential rise in mental

health concerns across all ages and sectors. Symptoms of social anxiety, depression and stress are the most common reported [1, 2] and their trajectory over time remains largely unknown. The two year acute period of the COVID-19 pandemic in Australia, and globally, pushed the limits of global health care systems which are still recovering, four years after initial lockdown measures and disease outbreak. The urgency and unprecedented nature of the COVID-19 pandemic response in Australia also resulted in great strides towards the development and deployment of digital and remote healthcare, professional, personal and academic systems, allowing for continued communication and collaboration despite strict isolation measures designed to control disease spread. These strategies have resulted in a plethora of mental health apps aimed at reducing symptoms of distress and anxiety; and in parallel optimise coping skills and early help seeking behaviours. Despite the many benefits of digital solutions compared to other health care methods, it is still unclear whether this is a practical and efficacious alternative that is able to meet the needs of users [3].

Digital Landscape

Alongside the rise of digital tools and products available in the previous decades, we also saw a rise of mental health smartphone apps and digital tools focusing on both preventative mental health care and alternative access to professional mental health services. Where apps focusing on clinical care and accessing professional support could monitor app quality of service based on the providers they engage with, there is less quality control happening in the preventative mental health space. Preventative mental health care apps are those designed to improve overall mental health, promote early help seeking through early recognition and the reduction of stigma towards mental health, and in general promote mental health understanding and literacy for the user through evidence based methodology. These apps do not provide any access to mental health or health professionals, this paper will focus on preventative mental health apps moving forward.

The mental health apps being downloaded and used en masse are not necessarily the same ones that are being strictly and scientifically assessed by mental health professionals. A review published prior to the COVID-19 pandemic [4] had already begun the process of assessing the scientific claims attached to mental health apps being promoted or spotlighted by the two most popular App stores ‘Google Play Store’ and ‘Apple App Store’. Of the 73 mental health apps on these app stores reviewed 44% used broad scientific language such as ‘evidence-based’ with no additional evidence or explanation provided, 33% highlighted scientific methods in their design but provided no further evidence, only 2 apps (2.7%) mentioned evidence directly related to the app, only 1 app (1.4%) provided the user with the reference/link to the evidence, and 5 apps (6.8%) referenced research that was currently underway. Many apps also spoke to technical expertise in the design (23 out of 73) and even less spoke to lived experience in the design process (10 out of 73). The most popular apps available in 2024, according to Forbes Health [5], include two mindfulness and sleep apps that are behind paywalls for access to the vast majority of functionality, two mood tracking and coping behaviour apps with a free limited access and paid complete access, and one app using evidence-based assessments and exercises also under a free to paid tiered subscription. All of these apps with at least 100,000 downloads and higher than four out of five star ratings on app stores. However, where all claim to be evidence based, at the time of writing this study none of these apps list any published research or evidence on app store listings, and only one linked their single research paper through their website, one claimed over 40 research papers published but did not link to them directly. These apps are seeing wide uptake and popularity despite unclear research efficacy and limited functionality which should be acknowledged with care where poor first impressions of mental health apps may influence the future uptake and use of similar tools for years to come.

The Research and Industry Dichotomy & Understanding co-design.

Although there is a lack of supporting evidence for the most popular and widely known mental

health apps, this does not mean there are no truly evidence based apps. Many apps have been developed and tested by researchers, clinicians, and lived experience experts, built on high quality testing and research available through reputable journals [6-11]. However these apps built by research and health provider teams are often not surviving through initial deployment and are not proving self-sustainable in the market despite finding promising user engagement indicators during structured testing [12]. The market available today seems to discriminate between popular and evidence based apps, with minimal ability to meet both targets. This discrepancy may be due to the training of the teams, focus of development, and selected performance indicators of these research based teams. The most popular apps are built by for-profit organisations with some expert input and research based apps are built by researchers and clinicians with little to no experience in design, development, and promotion, or limited focus on key marketing and usage indicators that are often the core focus of for-profit teams.

One key development method often utilised in business and product design, but less so in the research and clinical spaces, is that of iterative user centred systems design [13-15]. Inherently a difficult, time consuming, and agile methodology, these steps are not always utilised in the research and clinical space. User centred design (UCSD) [13] highlights the importance of incorporating users into every stage of design and development, ensuring that elements are explored with potential users prior to costly and time consuming development stages. Low cost prototypes or minimal viable products are then reviewed, improved, and redeveloped based on feedback. This iteration is a critical process to any successful app or digital deliverable, to ensure the digital tools are meeting the needs of their potential user base. The Monash Thrive app, a smartphone app designed and developed by a team of both researchers in the mental health space and user-experience/interface designers and software engineers, utilised both a research based approach to measurement and the steps of UCSD. This app was designed as a preventative mental health care app with a focus on early recognition and promotion of future help seeking behaviours through targeted mental health literacy.

This current study will explore the mental health outcomes of two distinct trials of the Monash Thrive app with University students. In trial 1, we tested the minimal viable product based on initial user discussions and market analysis. In trial 2, we completed further analysis of the second iteration beta product of the Monash Thrive app, redesigned and new features implemented post trial 1 feedback from users. It is hypothesised that throughout both trials there will be an improvement in mental health outcomes from using the app over the trial period. It is also hypothesised that the second trial will show a greater improvement in mental health outcomes given its re-iteration based on user feedback.

Method

Study Design

Throughout both trial 1 and trial 2 convenience sampling was used. The opportunity to take part in the study was advertised to students through on-location and online advertising in common student areas. Participants in trial 1 were also invited to take part in trial 2 if they had previously opted-in to be re-contacted and invited to take part in trial 2. Trial 1 was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12622001054707) and approved by the Monash University Human Ethics Committee (MUHREC) (ID# 30475) . Trial 2 was registered with the Australian and New Zealand Clinical Trials Registry (ACTRN12623000131651) and approved by the MUHREC (ID# 32761). Further details about trial 1 and 2 can be found in the procedure.

Across trial 1 participants were offered $10 reimbursement per survey they responded to across the trial period. Trial 1 included 4 weeks, plus an additional $20 reimbursement if participants took part in focus groups running post-trial, a maximum of a $60 online gift card could be provided if the

participant completed all trial surveys and a focus group. Of the initial 135 students invited to participate, 79 participants completed at least one item of interest at both timepoints (pre-trial and post-trial) and were included in the trial 1 analysis. The same sampling and promotion methods used in trial 1 were also used in trial 2, participants who took part in trial 1 were also invited to express interest in trial 2 if they had previously opted-in to be re-contacted. Of the initial 100 students invited to take part, 43 participants completed at least 1 item of interest across both timepoints (pre- and post- trial) and were included in the trial 2 analysis.

Participants

All demographic data surrounding participants from both trial 1 and 2 can be found in table 1. There were no participants included in the final samples of trial 2 that also took part in trial 1.

Table 1. Demographic statistics for trial 1 and 2.

		Trial 1 (*N*=79)		Trial 2 (*N*=43)	
		Average	Standard Deviation	Average	Standard Deviation
Age		21.23	4.96	23.12	6.30
		N	Percentage	N	Percentage
Gender	Female	63	79.7	32	74.4
	Male	14	17.7	10	23.3
	Other	2	2.5	1	2.3
International student status		55	79.7	33	76.7
Year Level	First	46	58.2	21	48.8
	Second	17	21.5	10	23.3
	Third	9	11.4	9	20.9
	Fourth	7	8.9	3	7.0
Location	Australia	79	100	42	97.67
	Victoria	79	100	41	95.35
Type of Device	Android	29	36.8	16	37.2
	Apple	50	63.2	27	62.8

Measures

Mental Health Literacy

The mental health literacy items used in the current study were developed by researchers based on current literature available exploring similar domains and larger scale measurement options [16]. The

items developed focused on mental health literacy as an awareness of personal wellbeing and mental health rather than the awareness of mental health and psychology as a field which we distinguish in the current study as a separate entity of psychological literacy. Items were also developed in terms of awareness of mental health and mental health services that may facilitate or hinder help seeking intention and behaviour based on previous research [17]. Five items were used, all positively phrased, participants were asked to respond to each prompt based on their current situation using a 5-point likert scale from 'strongly disagree' (1) to 'strongly agree' (5) with a middle option of 'unsure' (3). These five items were 'I feel I understand what mental health is', 'I am able to recognise when I am struggling psychologically', 'I am aware of strategies to manage my mental health', 'If I was struggling with my mental health I am confident I am able to access the help I need' and 'I feel I am aware of the support available to me from mental health professionals'. The current study used a mental health literacy total score for analysis calculated as an averaged score of all five items, as such average scores lower than 3 represent a preference for 'disagree' as a response and average scores 4 or higher represent a preference for 'agree' as a response. For all items at initial testing (week 0) in trial 1 was α=.75 and α=.82 for week 0 in trial 2.

Anxiety and Depression

Anxiety and Depression symptom scores were measured using the PROMIS (Patient Reported Outcome Measurement Information System). To measure Anxiety the PROMIS Anxiety [18] 4a short form scale asked participants to respond to a series of prompts in relation to their experiences in the seven days prior to answering. Four prompts are included in the 4a including 'I felt fearful', 'I found it hard to focus on anything other than my anxiety', 'My worries overwhelmed me' and 'I felt uneasy'. Participants answered on a scale of 1 (never) to 5 (always). Depression was measured similarly using the PROMIS Depression 4a [19] scale measuring how often participants experienced each prompt ('I felt worthless', 'I felt helpless', 'I felt depressed', and 'I felt helpless') using the same likert scale between 1 to 5. Anxiety and Depression scores are calculated through summation of all items into a raw score and translation into t-scores based on the raw-score in accordance with the PROMIS Anxiety and Depression scoring manuals. Within this study all items for Anxiety at initial testing (week 0) in trial 1 demonstrated α=.86 and α=.83 for week 0, trial 2. For Depression, initial testing (week 0) in trial 1 demonstrated α=.93 and α=.91 for week 0, trial 2.

Perceived and personal stigma

The stigma and worry of repercussions of using mental health support items were written by researchers. In total four negatively phrased items were used, these items included 'if I see a counsellor or psychologist I'm worried others would find out' (item 1), 'if I see a counsellor or psychologist I'm worried others would judge me' (item 2), 'Most people would think less of someone who has received mental health treatment' (item 3) and 'I would think less of someone who has received mental health treatment' (item 4). Participants responded to each item based on their current experiences using a 5-point likert scale ranging from 'strongly disagree' (1) to 'strongly agree' (5), with a middle response option of 'neither agree nor disagree' (3). These items were developed based on mental health literature focusing on self and perceived stigma towards mental health and engaging in mental health support from a health professional [20]. Personal bias was measured using item 4, perceived bias was measured using the average score of items 1, 2 and 3.

Help seeking intentions

The current study used an adapted and shortened version of the General Help Seeking Questionnaire (GHSQ) [21]. Originally a 2 item scale asking participants of their intention to seek help from a range of sources if they were experiencing emotional or personal distress (item 1) and if they were experiencing thoughts of self harm or suicide (item 2). Only item 1 was used in this study as the research and app intervention are focused on preventative mental health, rather than acute concerns

such as thoughts of suicide. Help seeking source prompts used in both items included ‘friends’, ‘intimate partner’, ‘parent’, ‘other relative’, ‘mental health professional’, ‘phone helpline’, ‘doctor’, ‘minister or religious leader’, ‘I would not seek help’, and ‘I would seek help from other’ with a free text option. To adhere closely to items of interest only, this current study will only review responses to the ‘Friend’ and ‘University Mental Health Provider’ and ‘External Mental Health Provider’ items and added two additional items including ‘Website or Forum’ and ‘Smartphone App’. Participants then responded to each help seeking source prompt on a 7-point likert scale from ‘extremely unlikely’ (1) to ‘extremely likely’ (7) with a middle option of ‘neither likely nor unlikely’ (4). The alpha for the original GHSQ is α=.70. The current study will explore each help seeking item individually through an average score for each help seeking prompt, these prompts will be referred to as ‘help seeking sources’ throughout this study.

Procedure

Monash Thrive app

The app utilised throughout this paper is the Monash Thrive app developed internally by the Monash THRIVE team throughout 2020-2023, launching in its complete form to the University community late 2023 [22]. The Monash Thrive app is a preventative mental health app with a focus on improving mental health literacy, awareness of personal wellbeing, and promoting help seeking behaviours to both personal and professional support networks. The core functionality of the Monash Thrive app is the mood check in feature allowing users to check in their mood across 7 co-interpreted emotions (‘Chill’, ‘Happy’, ‘Excited’, ‘Stressed’, ‘Sad’, ‘Angry’, and ‘Meh’), from these high order emotions users can then add additional feelings (for example ‘Meh’ has additional feelings to choose from including ‘Bored’ and ‘Disconnected’). After selecting a high order emotion and associated feelings users can select a contributing factor (e.g. ‘Study’, ‘Career’) that includes a customised add option for users to add factors not listed. From there users can also include a verbal to text or text diary entry. Based on mood check ins, users are then recommended resources from a library of short form mental health literacy tools. Example titles of these mental health resources included ‘Understanding Anger’ and ‘Balancing work and study’, where each resource is approximately a 5 minute read in conversational language. The mood check in and resources are the fundamental elements of the Monash Thrive app throughout both trials however additional features were added in trial 2. See table 2 for differences in app functionality in trial 1 (pre-user feedback) and trial 2 (post-user feedback). Please note the final released Monash Thrive app contains additional features not tested in this study.

Table 2. Core Monash Thrive app functionality across trials

Feature	Description of use	Trial 1	Trail 2
Mood check in	Multi stage mood check in with preselected emotion (7 option), feelings (between 7 and 15 options), and associated factor with customisation option. Check in includes diary entry options (text and voice to text). Users are encouraged to check in at least once a day.	Yes	Yes
Mental health literacy resources	Short form (5 minute read) written resources focusing on discrete areas of mental health literacy relevant to the user group. View options include long form text and ‘card flip’, a series of swipeable cards with less than 50 words per card.	Yes	Yes

Characters and Customisations	An interactive character ‘Moody’ who reacts to mood check-ins and interaction. Customisable colour palette of five colours and customisable notifications.	Yes	Yes
Personal analytics	Based on users own ‘mood check in’ they can see a summarised and graphical summary of how they have checked in their mood over the previous week to month, this includes most common moods, most common factors relating to mood etc.	No	Yes
Calendar	A calendar widget that allows users to go back to inputs or input new information across their entire usage time frame.	No	Yes

Trial 1

Trial 1 tested the minimum viable product (MVP) of the Monash Thrive app, a preliminary minimal functionality version of the app with foundational features based on the core functionality of commercially available products within the preventative mental health field. Trial 1 spanned across approximately six weeks of measurement and 4 weeks of active app usage across the first teaching semester of the year. Upon completion of the expression of interest survey participants were then sent the initial onboarding survey. If completed the participants were sent instructions via email on how to download the ‘testing’ version of the Monash Thrive app (not publicly available on app stores at time of testing), All future surveys included a check that participants had successfully downloaded and started using the app, if any participant expressed difficulty installing the app on their device researchers would individually reach out to support. A full breakdown of trial timing and surveys is demonstrated in figure 1.

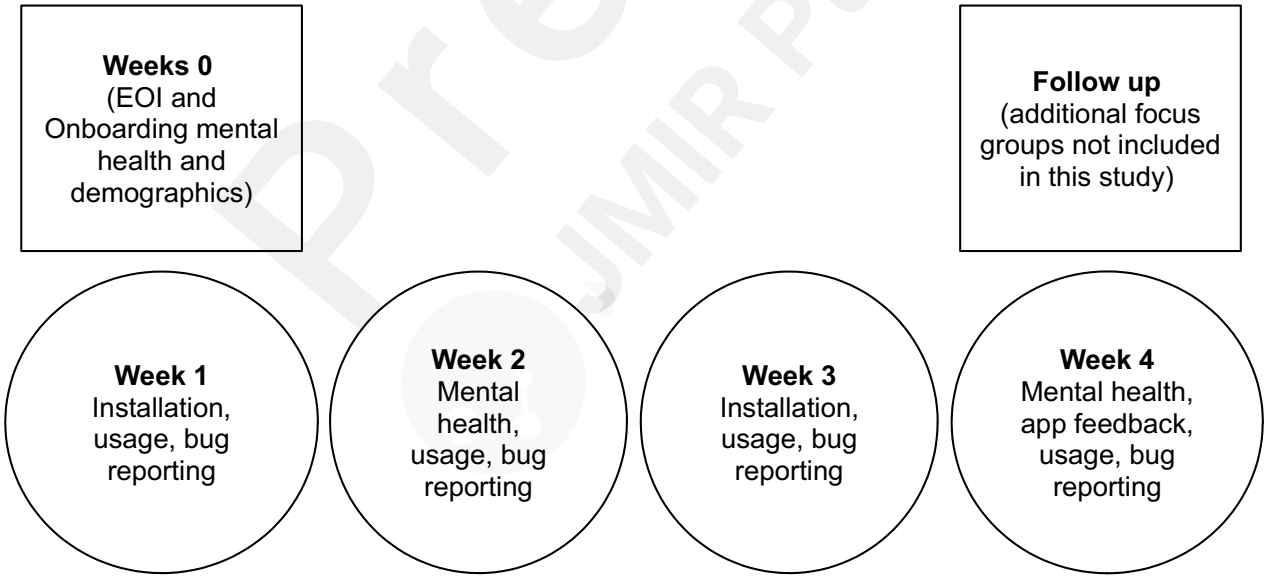

Figure 1. *Visual representation and summary of trial 1 of the Monash Thrive app MVP.*

Trial 2

Trial 2 tested the second iteration, beta version, of the Monash Thrive app after MVP testing. Additional features listed in table 1 alongside significant fixes and adjustments of existing features created the beta version of the app, tested in the second teaching semester of 2022 over the course of

approximately 13 weeks, including 1 week of onboarding and app installation followed by 12 weeks of active usage across the teaching semester. Participants were recruited and onboarded on a rolling basis over the course of five weeks leading to 5 groups of participants (one formed each week) each completing the trial sequentially after completing the 12 weeks of testing. A full breakdown of trial timing and surveys is demonstrated in figure 2.

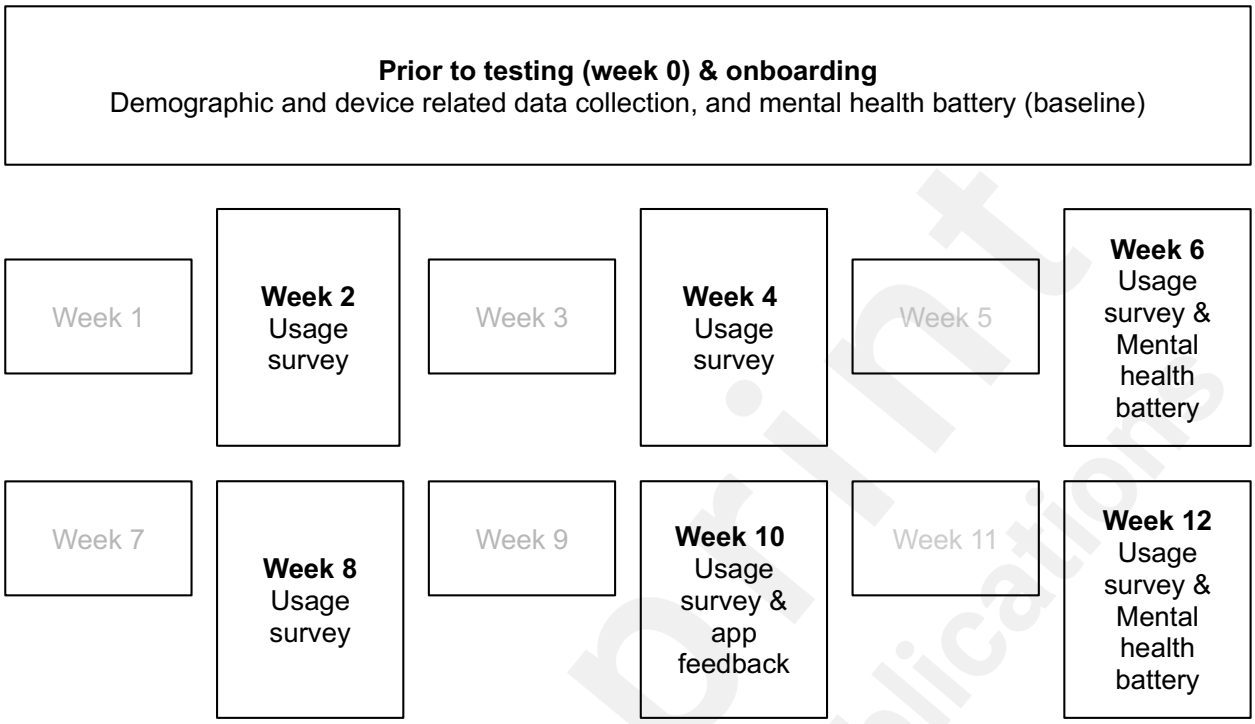

Figure 2. *Visual representation and summary of trial 2 of the Monash Thrive app Beta.*

Transparency and Openness

Materials and analysis code for this study are not available. This study was not pre-registered.

Data Analysis Plan

To address the first hypothesis comparing mental health related outcomes across trial 1 and 2 data was analysed through a series of paired sample t-test analyses, across the initial testing time point (pre-trial) and final testing time point (post-trial). Outcomes included wellbeing, anxiety and depression total scores, mental health literacy total scores, personal stigma (single item) and perceived stigma average score, and 5 targeted help seeking intention scale (GHSQ) prompts including Friends, University Mental Health Professional, External Mental Health Professional, Smartphone Apps, and Websites and Forums. Based on outcomes from the assessment of hypothesis 1 an additional series of repeated measure ANOVA analysis will be run across trials to measure hypothesis 2.

Results

Trial 1

Descriptives for all dependent variables can be found in table 3. All assumptions of normality and differential normality were assumed based on either Shapiro-Wilk analysis, observation of the relevant histogram or quantile plots. One outlier was identified through standardisation (> 3.29) and removed from the mental health literacy post-testing variable. All following analysis was only completed for participants who completed all items of interest across the two timepoints, total numbers fluctuated slightly across variables tested. Inferential statistics can be found in Table 4.

Table 3. Descriptive outcomes for trial 1 analysis.

Outcome	Timepoint	N	Mean	Standard Deviation
Mental health literacy	pre-	75	3.84	.58
	post-		4.15	.54
Anxiety	pre-	78	61.06	8.55
	post-		59.38	7.21
Depression	pre-	79	56.74	9.47
	post-		55.92	9.16
Perceived Bias	pre-	69	2.24	.76
	post-		2.07	.74
Personal Bias	pre-	69	1.26	.50
	post-		1.35	.70
Help Seeking (Friend)	pre-	71	5.55	1.44
	post-		5.34	1.40
Help Seeking (University Mental Health Professional)	pre-	71	4.18	1.75
	post-		4.37	1.73
Help Seeking (External Mental Health Professional)	pre-	71	4.44	1.73
	post-		4.59	1.69
Help Seeking (Smartphone Apps)	pre-	71	3.56	1.89
	post-		4.06	1.80
Help Seeking (Websites and Forums)	pre-	71	3.35	1.85
	post-		3.80	2.03

Table 4. Trial 1 Inferential outcomes

Outcome	Degrees of freedom	t	CI [Lower, Upper]
Mental health literacy	74	-4.61	[-.44, -.18]***
Anxiety	77	1.87	[-.11, -3.47]*
Depression	78	.79	[-1.23, 2.88]

Perceived Bias	68	1.45	[-.07, .41]
Personal Bias	68	-.85	[-.29, .12]
Help seeking (Friend)	70	.90	[-.26, .68]
Help seeking (University Mental Health Professional)	70	-.63	[-.77, .40]
Help seeking (External Mental Health Professional)	70	-.56	[-.71, .40]
Help seeking (Smartphone Apps)	70	-1.67	[-1.08, .10]*
Help Seeking (Websites and Forums)	70	-1.46	[-1.07, .16]

NOTE: * p<.05, *** p<.001 (one-sided)

Of the variables assessed, a significant improvement across initial and post testing timepoints was only found for mental health literacy, anxiety, and help seeking intentions for smartphone apps.

Trial 2

The same outcomes were assessed through the second iteration trial of the Monash THRIVE app through the series of paired sample t-tests. All assumptions of normality and differential normality were assumed for all variables. No outliers were identified. Descriptive statistics for trial 2 can be found in table 5, and inferential statistics in Table 6.

Table 5. Trial 2 Descriptive outcomes

Outcome	Timepoint	N	Mean	Standard Deviation
Mental health literacy	1	42	3.92	.57
	2		4.03	.48
Anxiety	1	43	60.40	6.73
	2		58.99	8.32
Depression	1	43	55.89	8.96
	2		55.77	8.45
Perceived Bias	1	42	2.32	.82
	2		2.06	.90
Personal Bias	1	43	1.51	.77
	2		1.44	.77

Help Seeking (Friend)	1	43	5.05	1.57
	2		5.44	1.52
Help Seeking (University Mental Health Professional)	1	43	4.42	1.59
	2		4.63	1.45
Help Seeking (External Mental Health Professional)	1	43	4.49	1.79
	2		4.23	1.63
Help Seeking (Smartphone Apps)	1	43	4.47	1.68
	2		4.42	1.89
Help Seeking (Websites and Forums)	1	43	4.28	1.69
	2		4.40	1.94

Table 6. Trial 2 Inferential outcomes

Outcome	Degrees of freedom	t	CI [Lower, Upper]
Mental health literacy	42	-1.24	[-.29, .07]
Anxiety	42	1.26	[-.84, 3.66]
Depression	42	.08	[-2.94, 3.19]
Perceived Bias	42	1.49	[-.09, .62]
Personal Bias	42	.57	[-.18, .32]
Help seeking (Friend)	42	-1.24	[-1.03, .25]
Help seeking (University Mental Health Professional)	42	-.78	[-.75, .33]
Help seeking (External Mental Health Professional)	42	.85	[-.35, .86]
Help seeking (Smartphone Apps)	42	.15	[-.58, .67]
Help Seeking (Websites and Forums)	42	-.38	[-.74, .51]

Of all variables assessed there was no significant difference noted in any variable across pre- and post- trial testing for trial 2 of the Monash Thrive app. As no variables were significantly different in trial 2 no additional comparisons were included to compare the degree of differences within trial 1 and trial 2.

Discussion:
The present study assessed changes in mental health outcomes over time throughout two iterative trials of the newly developed, preventative mental health app Monash Thrive. It was hypothesised that the testing of both the initial and secondary iterations of the app would demonstrate improvements in mental health outcomes across each trial (pre and post use). It was also hypothesised that the mental health outcomes would improve to a greater degree across the trial of the second iteration of the app due to increased functionality and improvements made across the testing and design process. The initial hypothesis was partially supported and the second hypothesis was not supported.

Initial 6-week testing of the MVP app demonstrated no significant changes in variables across pre-app use and post-trial testing aside from mental health literacy, anxiety, and intentions to seek help from smartphone apps. Outcomes improved across all three of these significant variables. Despite these significant differences it is unclear the impact of these changes across time for the individual. The core purpose of the app being tested was to provide users the platform and opportunity to both better understand their own wellbeing and mental health over time (using the wheel of feels function, and the personalised analytics in the second iteration) and to improve their understanding of mental health generally (using the mental health literacy resources). These findings demonstrate that after only four weeks of use there was an improvement in the users perceived mental health literacy. Usage of the app in the initial trial also demonstrated an increased likelihood of seeking help from mental health smartphone apps, a positive indication that the app even in its initial iteration was improving the overall impression of mental health smartphone apps for the user which may in turn improve the users willingness to try apps if needed in the future. The final significant finding from the initial trial was the improvement in anxiety related symptoms over time, despite the trial running throughout the middle of the teaching semester. This finding, although only an initial step towards understanding the mental health related efficacy of using the app, is a positive indication that the functionality and engagement with the app may be enough to also see improvements in other areas of mental health and wellbeing over time.

The second 12-week testing of the beta Monash Thrive app demonstrated no significant changes over time across all variables. Although these findings are not in support either hypotheses, the lack of significant differences over time whether improvements or declines in mental health outcomes, are a promising indication that where the engagement with the app may not improve the wellbeing of a student over time, it may measure its utility and usefulness as a preventative measure. Across both trials, testing began in the early stages of semester (trial 1 took place in the early weeks of semester 1, 2024 and trial 2 took place throughout semester 2, 2024) however only trial 2 ended near the end or at the end of the teaching semester. As such the improvements over time observed in trial 1 may not have been replicated in trial 2 due to the longer length of the testing period and the inclusion of testing across the later semester period when students engage with more complex final assessments, exams and increased deadlines nearing the end of semester.

This study highlights a novel approach to reporting in a research manner the efficacy of mental health smartphone apps by utilising an iterative approach, demonstrating efficacy in terms of mental health outcomes for initial MVP product and the second iteration of the product within the same study. Despite limited findings and support for hypotheses it is important to demonstrate the development of such smartphone apps over time and continuing to develop and measure efficacy of these tools beyond initial development. Limitations of this study should be noted for future research or mental health smartphone app development that plans to utilise a similar iterative reporting approach to development and research. For consideration are the differences in the length of time across trial 1 when compared to trial 2, in this case trial 1 took place over a four week testing period

including initial pre-testing data collection, with a total testing period of 6 weeks including post-trial focus groups. The second trial, although utilising the same measures of interest, took place over a period of 12 weeks. This difference may have significant implications for measuring efficacy of the app over differing time points with one of the most evident impacts being the difference between percentage of students completing at least one item of interest across timepoints for trial 1 (79 out of an initial 135) which demonstrated a 58.5% retention rate, compared to trial 2 (43 out of an initial 100) which demonstrated a 43% retention rate between initial survey after app download and final survey. This difference in length of the trials could have also contributed to a differing degree of increase in academic concerns over time for participants in trial 1 compared to trial 2. Future research should consider a complete replication of research protocol across iterations to ensure that the greatest number of confounding variables are accounted for.

In conclusion, the Monash Thrive app is one of the first of its kind to be iteratively co-designed primarily with its potential users within both a research and development setting. This app represents a next steps in the development of clinically and empirically supported mental health smartphone apps and digital tools that can utilise the same development methods as industry in order to ensure the next generation of digital mental health tools are not only valid but have the uptake and use necessary to sustain ongoing service provision and development. The current study reported the mental health outcomes across two iterative testing trials of the mental health app Monash Thrive. Current findings only offered limited support for the hypotheses where only some mental health outcomes improved over time in trial 1 (anxiety, mental health literacy and help seeking intentions towards smartphone apps) and no mental health outcomes improved over time in trial 2. These results may be confounded by timing of testing and differences in trial length between trial 1 and 2, however also demonstrates a potential for the testing and reporting of iterative development of mental health smartphone apps and the promotion of research and clinical fields utilising and reporting on the development strategies used in design, engineering, product development and business fields.

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Figures

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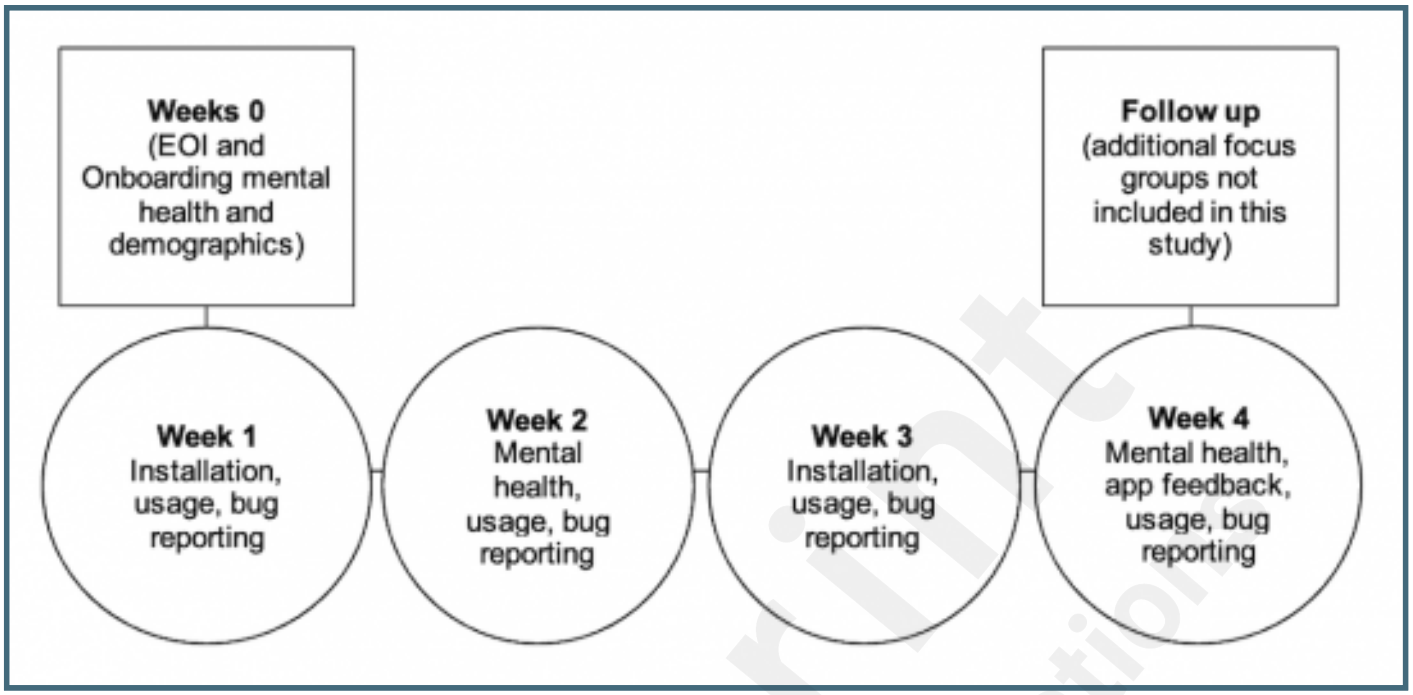
Visual representation and summary of trial 1 of the Monash Thrive app MVP.



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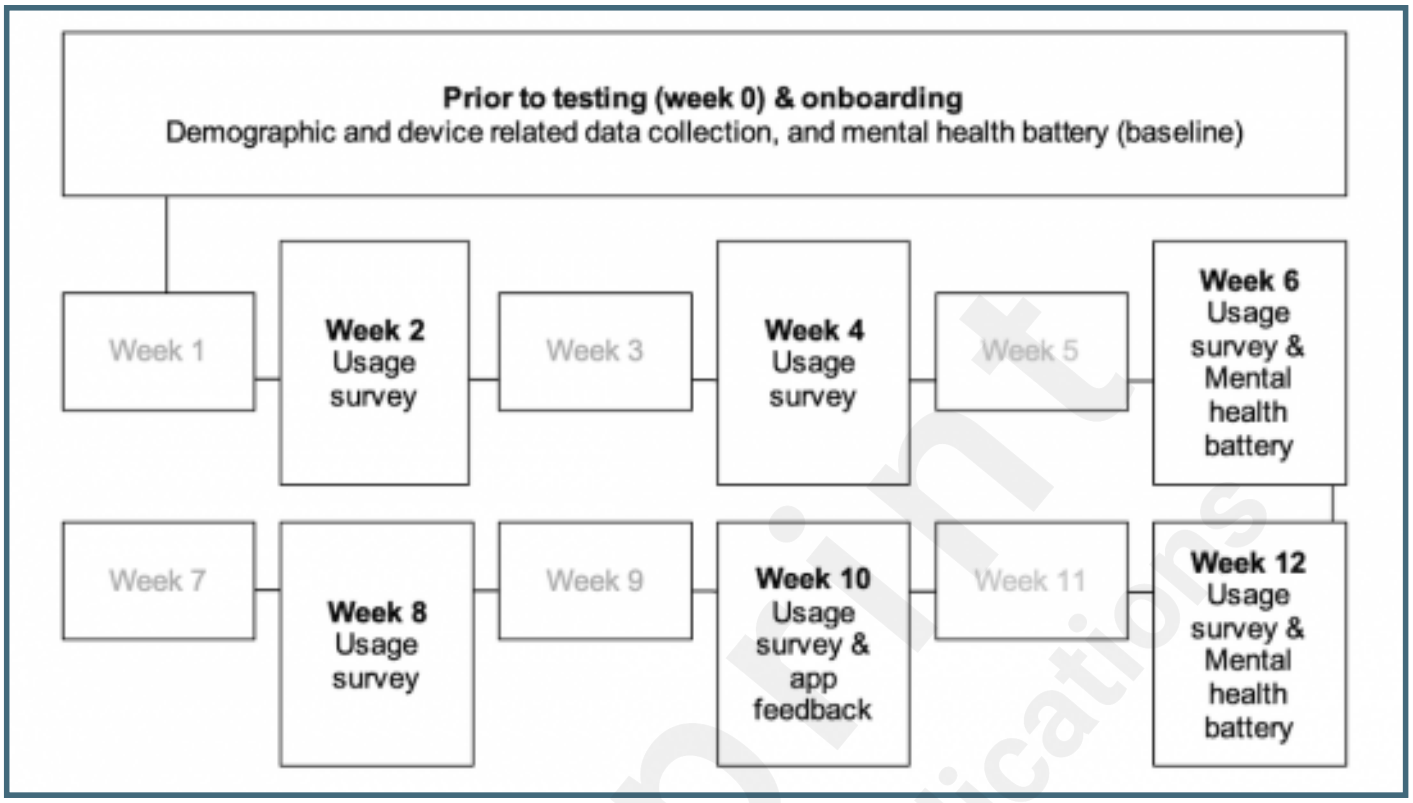
Visual representation and summary of trial 2 of the Monash Thrive app Beta.



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