MyHealthPA: Development and Pilot Testing of a Mobile-Based Monitoring Tool to Reduce Cardio-Vascular Disease Risk in People with Mental Health Problems

Abstract

Background: People with mental health disorders live on average 20 years less than those without, often due to poor physical health including cardio-vascular disease (CVD). Evidence-based interventions are required to reduce this lifespan gap.

Objective: This study aimed to develop, trial, and evaluate a mobile-based lifestyle program (MyHealthPA) to help people with mental health problems improve key health risk behaviors and reduce their risk of CVD.

Methods: The development of MyHealthPA occurred in three stages: (1) a review of the literature; (2) a scoping survey (n=251) among people with and without experience of mental health problems; and (3) program development informed by stages (1) and (2). A small pilot trial among young people with and without mental
health (MH) disorders was also conducted. Participants completed a baseline assessment and given access to the MyHealthPA program for a period of eight weeks. They were then asked to complete an end-of-treatment assessment and a follow-up assessment one month later.

**Results:** Twenty-eight young people aged 19 to 25 years were recruited to the pilot trial. Of these, 12 (43%) had been previously diagnosed with a MI. Twelve participants (43%) completed the end-of-treatment assessment and six (21%) completed the follow-up assessment. Small improvements in fruit and vegetable consumption, level of physical activity, alcohol use, and mood were found between baseline and end-of-treatment and follow-up, particularly among people with experience of MH issues. Most participants (57-60%) reported the program had above average usability, however only 29-40% of participants reported that they would like to use the program frequently and would recommend it to other young people. Participants also identified a number of ways in which the program could be improved.

**Conclusions:** This article describes the formative research and process of planning that formed the development of MyHealthPA and the evidence base underpinning the approach. The MyHealthPA program represents an innovative approach to CVD risk reduction among people with mental health problems. MyHealthPA appears to be an acceptable, easy to use, and potentially effective mHealth intervention to assist young people with mental illness to monitor risk factors for CVD. However, ways in which the program could be improved for future testing and dissemination were identified and are discussed.

**Keywords:** Telemedicine; Mental Health; Cardiovascular Diseases
Introduction

People with mental health (MH) disorders live on average, 20 years less than the general population [1]. Cardio-vascular disease (CVD) is the leading cause of this excess mortality, responsible for more deaths in this population than suicide [2]. Smoking, alcohol misuse, physical inactivity, and poor diet are consistently identified as the top four behavioral risk factors associated with CVD in the general population [3]. These modifiable behavioral risk factors are over-represented among people with MH problems [4]. These behaviors also commonly co-occur in clusters, which presents opportunities to adopt a multiple health behavior change approach, in which behavioral risk factors are targeted together, rather than in isolation.

Recent research has shown that changing multiple behavioral risk factors and reducing CVD risk is possible among people with MH problems [5]. However, due to time constraints, lack of awareness, training and resources, MH services often confine their services to MH issues alone; neglecting physical health and CVD risk [6]. Additionally, many people with MH problems do not access treatment for their concerns, with Australian data indicating that only around one third of people with a past 12-month MH problem having accessed treatment [7]. There is a need to develop effective interventions to address CVD risk among this population, and that are accessible both within and outside mainstream health and MH services. It is also imperative that these interventions are scalable and of low burden to both clinicians and patients.

Mobile-based interventions to reduce CVD risk may be able to address these needs. Through mobile devices, individualized interventions can be provided inexpensively to large numbers of people, including those who are geographically isolated, at a time
and place when they are ready to engage in treatment [8]. Mobile-based interventions have been shown to be effective in improving a range of behavioral risk factors associated with CVD including, physical activity, weight loss, alcohol use, and smoking cessation, as well as, MH problems including depression and anxiety [9]. They may also be especially useful in engaging people with MH problems with treatment. In a recent systematic review, Donker et al., [10] found adherence rates for smartphone applications targeting a range of MH issues were high [10]. This paper describes the development and initial evaluation of the first mobile-based monitoring tool to target multiple modifiable CVD behavioral risk factors (smoking, alcohol misuse, poor diet and inadequate physical activity) for people with MH problems (MyHealthPA).

**Methods**

**Development of MyHealthPA**

The development of MyHealthPA occurred in three stages: 1. Literature review; 2. Scoping survey among people with and without experience of MH problems; and 3. Program development. These stages are detailed below.

**Stage 1: Literature Review**

This stage aimed to identify, from previous research, the key strategies required to improve behavioral risk factors associated with CVD, and develop a mobile-based tool for use by people with MH problems. The main features considered in our review of the existing literature included the intervention content and the delivery and design of the intervention.
**Intervention Content**

Ward, White, and Druss [11] have conducted a meta-review of non-pharmacological lifestyle interventions for CVD risk factors among the general population, and those with severe mental disorders. All of the interventions they identified addressed behavior change related to diet and/or exercise, and revealed a number of common factors for success in these interventions. This was a common observation among the existing literature identified (i.e., a focus on diet and exercise, and not tobacco or alcohol misuse despite these being key behavioral risk factors for CVD, and highly prevalent among people with MH disorders). The Ward, White [11] review reported that many successful interventions employed cognitive-behavioral therapy (CBT) techniques (e.g., goal setting, self-monitoring of food intake and physical activity, and the use of a structured curricula to encourage behavior change), with use of a greater number of strategies associated with improved results. Other key elements of successful interventions included the use of multiple components (e.g., addressing diet and exercise and using CBT techniques), personalization of diet and exercise regimens, increased duration of the intervention, higher frequency of contact, and multidisciplinary teams. Of note was that face-to-face interventions (as opposed to computer-based interventions) were associated with better results in this meta-review. However, Ward, White [11] only included studies published prior to 2012, and did not include any mobile-based interventions. The field of technology-based behavior change interventions has grown considerably since that time, and thus this particular observation may no longer be valid. While fewer reviews of interventions among individuals with severe mental illnesses were identified, Ward et al., [11] found that among this sub-population, single component programs were also less effective than those employing multiple components, however few interventions among this population actually employed multiple components. Manualized
interventions were also rarely employed, group sessions rather than individually personalized interventions were more commonly used, and interventions were often of short duration.

Baker and colleagues have conducted the only trial to date of interventions for people with MH disorders targeting smoking and alcohol use, as well as, diet and exercise [5]. The trial compared an intensive face-to-face intervention with a brief telephone-based intervention, both of which used CBT and motivational interviewing techniques, including self-monitoring and goal-setting, to encourage behavior change across multiple targets. In both conditions, there were significant improvements in smoking abstinence, cigarettes per day, and expired carbon monoxide (CO) at 15-week and 12-month follow-up. A significant reduction in participants’ 10-year CVD risk was observed at 15-week follow-up, which continued to the 12-month follow-up for the brief phone-based condition. In a subsequent trial by the same group, a phone-based intervention targeting fruit and vegetable consumption, leisure screen time (a newer health behavior of increased research interest), and alcohol use was also associated with significant improvements in fruit and vegetable consumption, quality of life, leisure screen time and sitting time (also a new health behavior receiving increasing research interest) [12] in people with MH problems.

Key CBT techniques such as; self-monitoring and goal setting have been identified as central to successful CVD risk reduction interventions among people with and without MH problems. Meta-analyses provide evidence for the efficacy of self-monitoring of diet, physical activity and weight, tobacco, and alcohol use [13-16]. The ability of patients to easily monitor their behaviors and mood, set-goals and
track their progress through mobile-based interventions has also been identified as one of the many advantages of using mobile devices to deliver health and MH interventions [10, 17]. Electronic self-monitored mood has also been found to be valid compared to clinical rating scales of depression [18].

Delivery and Design of the Intervention

The available literature suggests that even the most popular existing mobile health apps (e.g., MyFitnessPal) have poor usability, even among the general population [19]. People with MH problems, particularly those with severe mental illnesses, can experience concomitant cognitive impairments, which may mean mobile-based interventions using standard design principles are less usable [8, 20].

Rotondi et al., [20] conducted a series of design and usability studies among persons with severe mental illnesses in order to create the first empirically based design model for the development of eHealth tools for this population. Their Flat Explicit Design Model (FEDM) contains 18 design recommendations which aim to reduce the cognitive effort required to effectively use an eHealth tool and thus allow these tools to be usable by persons with severe mental illnesses. This model recommends a “flat design” (with no more than two levels in the website or app’s site structure), using descriptive labels and explicit instructions (as opposed to succinct, but often abstract labels or symbols) and using text written at a low reading level [20, 21]. Employing this approach is argued to reduce the need for users to: think abstractly; rely on working memory to create a mental model of the site or app; utilize executive functions to search for information or explore the site or app effectively; and concentrate to filter out distracting contents.
Ferron et al., [21] have conducted some of the only research to investigate the usability of publicly available mobile health apps among people with MH problems. They investigated whether smoking cessation apps are usable by smokers with psychotic disorders. Twenty-one smokers with a psychotic disorder assessed the usability of nine smoking cessation apps (previously rated to be of high quality by expert reviewers). Their research identified multiple features of currently available smoking cessation apps that caused these apps to be inaccessible or ineffective among most smokers with psychotic disorders. These barriers included: the use of text heavy designs; difficulty navigating the apps due to the use of jargon and abstract symbols; and the use of subtle directions, such as the provision of only small symbols or one-word instructions as cues how to use the apps [21].

Stage 2: Scoping Survey among people with and without experience of mental health problems

In order to ensure the MyHealthPA program was tailored to the needs of people with MH problems, scoping research with potential end-users of the program was conducted.

Participants and Procedure

Participants were recruited via paid and unpaid advertisements on social media to participate in a brief survey of attitudes towards using mobile-based technology for health-related behaviors. Those who clicked on the study advertisements were taken to an online information statement and consent form, and then directed to the self-report questionnaire hosted by the online survey program Fluid Surveys, if they chose to participate. The survey was also sent to 200 members of a community research
register who were asked to return the consent form and self-report questionnaire in a reply-paid envelope. Participants were required to be aged over 18 years and currently living in Australia.

**Measures**
The survey included items regarding; demographic characteristics, mobile phone access and use, and openness to using mobile technologies for health purposes. Participants were also asked to indicate if they had ever been diagnosed with a MH problem. Current psychological distress was assessed using the Patient Health Questionnaire [PHQ4, 22]. Participants indicated if they were a current smoker (yes/no) and their use of tobacco and alcohol in the past 3 months (never, once or twice, monthly, weekly, daily or almost daily).

**Results**
Of the 722 people who accessed the online survey, 334 consented and were eligible to participate in the study, and 252 provided sufficient data to be included in the current analysis. Of the 200 members of the community research register contacted 35 returned completed questionnaires. The final sample of 287 participants were aged between 18 and 77 years (M=29.57, SD=13.96). The majority of participants were female (n=192, 66.9%), held a university degree (n=113, 40.4%) or had completed Years 11 or 12 of secondary school (n=82, 29.3%), were employed (n=142, 50.9%), and lived in a major city (n=218, 79.9%). Approximately half of participants reported a history of mental illness (n=105, 54.4%), however most (n=134, 70.2%) reported no (or mild) current psychological distress.

Of the 252 participants who provided information about their MH status, 144 (57.4%) reported experiencing MH problems, including 61 (24.3%) who reported a
history of mental illness and current psychological distress, 73 (29.1%) reporting a
history of mental illness but no current psychological distress and 10 (4%) reporting
current psychological distress but no history of MI. One-hundred and seven
participants (42.6%) reported neither a history of MI or current psychological distress.

Participants reported extremely high levels of access to mobile technology,
with 93.5 - 100% of participants reporting they owned or had easy access to a
smartphone. The majority of participants had previously used their mobile phone to
access information or treatment for physical health concerns (184, 73.0%). Most
participants with a history of mental illness or current psychological distress had also
done so specifically for MH concerns (114, 78.6%). Fewer had accessed information
or treatment for drug and alcohol concerns (52, 23.4%). Across these different types
of health concerns most participants reported that they would consider accessing
treatment via a mobile phone (62.3- 75.8%).

When asked if they were interested in receiving information or treatment via a
smartphone about a range of health concerns, few participants (15.5 – 29.0%) were
interested in specifically addressing CVD (See Table 2). However, more participants
did express interest in addressing key CVD behavioral risk factors. For example, most
participants were interested in addressing physical activity (n=133, 60.5%) and diet
(n=109, 77.0%), via a smartphone. Among those with MH problems (i.e., a history of
mental illness and/or current psychological distress, n=110), the majority were also
interested in addressing mood (62.3 – 64.6%) and MH issues (74.5-77.8%).
While very few of participants overall were interested in addressing smoking (n=25, 11.5%) or alcohol use (n=28, 12.8%) via a smartphone, interest in addressing these issues was higher among frequent users of these substances. Among participants reporting daily (or almost daily) use of alcohol, 60% (n=6/10) of participants with a MH problem (current distress and/or history of MI) reported that they would be interested in addressing alcohol use via a smartphone. Only 17% of daily drinkers without a MH problem were interested in addressing alcohol use via a smartphone (n=2/12). Similarly, among daily smokers, 81.3% (n=13/16) of participants with MH problems were interested in addressing smoking, and 75% (n=3/4) of smokers without a MH problem were interested in addressing smoking.

Table 2. Interest in addressing specific health issues via a smartphone.

<table>
<thead>
<tr>
<th>Health Issue</th>
<th>Hx MI, Current Distress</th>
<th>Hx MI, No Distress</th>
<th>No MI, Current Distress</th>
<th>No MI, No Distress</th>
</tr>
</thead>
<tbody>
<tr>
<td>Diet</td>
<td>46.7%</td>
<td>57.7%</td>
<td>44.4%</td>
<td>52.3%</td>
</tr>
<tr>
<td>Physical activity</td>
<td>57.6%</td>
<td>70.4%</td>
<td>66.7%</td>
<td>63.6%</td>
</tr>
<tr>
<td>Cardio-vascular disorder</td>
<td>15.5%</td>
<td>29.0%</td>
<td>22.2%</td>
<td>23.6%</td>
</tr>
<tr>
<td>Smoking</td>
<td>19.3%</td>
<td>10.1%</td>
<td>22.2%</td>
<td>4.7%</td>
</tr>
<tr>
<td>Alcohol use</td>
<td>15.5%</td>
<td>25.7%</td>
<td>22.2%</td>
<td>12.3%</td>
</tr>
<tr>
<td>Mood</td>
<td>66.7%</td>
<td>60.0%</td>
<td>66.7%</td>
<td>26.4%</td>
</tr>
<tr>
<td>Mental health</td>
<td>74.6%</td>
<td>76.4%</td>
<td>80.0%</td>
<td>35.8%</td>
</tr>
</tbody>
</table>

Note: Hx MI = History of Mental Illness, MI = Mental Illness = History, Distress = Psychological distress

**Stage 3: Program Development**

The initial content of MyHealthPA was informed by the review of the literature and survey research described above. This research suggested it is appropriate to address CVD risk for people with MH problems using a mobile-based
intervention. It also highlighted that the MyHealthPA program needed to, at a
minimum, include self-monitoring and goal-setting techniques, provide feedback on
users’ behaviors, adopt a multiple health behavior change framework and should
address individual risk factors as opposed to CVD specifically. The initial content
was written so that it was brief, there was minimal introductory content, it explicitly
communicated concepts, and was easy to read, in line with the principles of the
FEDM [20].

Two academics and two clinicians with expertise in health behavior change
among people with MH problems reviewed the initial written content. Feedback on
the initial content was that it was accurate and correct in accordance with the most
current research and behavior change techniques. Any information that was queried
was checked with the literature and changed accordingly. Minor changes to the
language to improve the readability of content were also made.

A beta version of the MyHealthPA program was then developed, and reviewed
by two academics, two clinicians, and two MH consumers. The beta version of
MyHealthPA was informed by the FEDM [20]. For example: the program was
designed so that it had a shallow hierarchy, therefore to access the majority of features
of the program users need only go one level past the initial home screen, and to only
two levels for a minimal number of features; a simple pop-up menu bar at the top left
of the home screen was used to facilitate navigation and comprehension; and a
relatively plain visual design was employed to reduce distractions for users. During
the beta feedback phase, reviewers were asked to rate their mood using a set of
‘emoticons’ representing different ways they might be feeling (e.g., Happy, Calm,
Tired, Lonely, Sad, Angry, Depressed) to determine the validity of using these images and labels to represent mood.

Based on feedback from reviewers, the emoticon mood rating system was changed to a 10 point Likert scale where, in response to the question ‘How do you feel today?’ users could indicate their mood. Descriptors of 1= the worst I have ever felt of could ever imagine feeling, 5= in the middle, neither very bad or very good, and 10= the best I have ever felt or could ever imagine feeling, were used to help guide users’ responses. If users select ‘1’ on this scale they are automatically presented with a pop-up message asking if they are ok and provided with the contact details for emergency helplines (e.g., Lifeline, Kids Help Line) and instructed to call emergency services if life is in danger or they are in need of emergency assistance.

**The MyHealthPA Program**

MyHealthPA provides users with feedback regarding smoking, alcohol use, fruit and vegetable consumption, and physical activity, allows users to easily record their health behaviors and mood on any mobile device, and track their progress over time. Users can also set health behavior goals and are sent reminders to record behaviors (See Figure 1).

When users first access MyHealthPA they are asked to complete a brief questionnaire regarding their health behavior and mood, at the end of which they are provided with personalized feedback regarding their health behaviors based on [23-25] national guidelines. Users can then access the full MyHealthPA program which consists of seven pages or sections. They are:
1. **Home page:** This page provides a simple, visual portrayal of the current day's diary entry, a motivational quote from the Personal Assistant avatar and a menu to access all other pages.

2. **My Diary:** This page allows users to record their mood and health behaviors (number of cigarettes, number of alcoholic drinks, minutes of physical activity, and/or serves of fruits and vegetables consumed) for the day. Participants can also record if they have taken any medications as prescribed that day and any withdrawal (scale name) or adverse psychiatric symptoms (scale name) they may have experienced.

3. **My Progress:** This page allows users to view their progress via an interactive graph that users can use to display changes in multiple health behaviors and/or mood over time.

4. **My Goals:** This page allows users to set goals, including due dates for these goals, related to each of the measured health behaviors (e.g., Set a quit date and quit smoking, reduce the number of alcoholic drinks I drink in a day to XX, eat 2 servings of fruit per day, exercise XX times per week) and displays any current goals they have set. A pop-up text box also provides users with tips on setting SMART (Specific, Measurable, Active, Realistic and Time limited) goals.

5. **My Profile:** On this page users can enter and edit their personal information (e.g., Name, gender, height, weight, and contact details and any medications they are taking) and customize the notifications they receive from the program.

6. **Resources:** This page provides links to online resources that contain extra information and tips about changing health risk behaviors.

7. **Emergency:** This page provides contact details for relevant helplines. Participants are instructed to contact one of these services or contact
emergency services if they are thinking about suicide or experiencing a personal crisis.

MyHealthPA was developed as a responsive website (as opposed to a native, downloadable app) optimized for use on a mobile phone, but that also allowed users to view the program on any device with internet access.

**Pilot testing**

In order to evaluate the feasibility and potential efficacy of MyHealthPA, particularly among people with MH problems, a pilot study was conducted among young people with and without a previous diagnosis of a mental illness. The pilot study utilized a pre-post design. Participants were recruited via flyers placed on university campuses, paid and unpaid advertisements on social media (e.g., Facebook/Twitter) and on the lead author's institution website.

Potential participants were asked to complete an initial online screening questionnaire. To be eligible, participants were required to be aged 18 to 25 years, live in Australia, and have access to a Smartphone with Internet access. Upon meeting eligibility criteria, participants were asked to provide informed consent and complete an online baseline assessment. They were then given access to the MyHealthPA program for a period of eight weeks, after which they were asked to complete an online end-of-treatment assessment and an online follow-up assessment one month later (12 weeks after baseline). All online assessments were hosted by Survey Monkey.
**Measures**

The baseline assessment contained items regarding: demographic characteristics; medical history, including if they had ever been diagnosed with a mental illness; frequency of mobile phone use; use of mobile health apps; current health behaviors; and current psychological distress (using the 4-item version of the Patient Health Questionnaire [PHQ4: 22].

The health behaviors measured were smoking (smoking status and cigarettes per day) alcohol use (Alcohol Use Disorders Identification Test – Consumption items, AUDIT-C [26]), a brief measure of hazardous and harmful alcohol use), diet (serves of fruits and vegetables consumed per day) and physical activity (International Physical Activity Questionnaire, IPAQ [27]). This information was then used to calculate participants’ Lifestyle Risk Index (LRI) [28]. The LRI is a composite score which represents compliance to national guidelines for the four health behaviors. Each behavior is assigned a score of ‘0’ (compliance with guidelines; ‘not at-risk’) or ‘1’ (non-compliance with guidelines, ‘at-risk’). Scores are then summed for an overall LRI score. The LRI method has been previously validated by Ding and colleagues [28] in a large cohort of Australian adults. Furthermore, such an approach has been recommended for generating quantifiable outcomes in interventions for multiple risk factors [29].

Participants’ health behaviors and current psychological distress were also assessed at end-of-treatment and follow-up. Additionally, as a part of the end-of-treatment assessment participants were asked to answer a series of questions related to the usability and acceptability of MyHealthPA which included the System Usability Scale [SUS: 30], and open ended questions regarding which sections of the program
participants’ felt worked well, did not work well and any suggested improvements to the program.

Results

A total of 102 participants completed the initial online screening questionnaire. Of these, 35 were eligible to participate and provided informed consent, however seven did not complete the online baseline questionnaire, leaving a total of 28 participants who were included in the pilot study and granted access to the MyHealthPA program. A total of 12 participants also completed the end-of-treatment online assessment, and 6 participants completed the follow-up assessment one month later.

Participant characteristics

Twelve participants (42.9%) reported that they had previously been diagnosed with a MI. Descriptive statistics are reported separately for participants with and without a history of MI. As can be seen in Table 3, the majority of participants in both groups were female. Participants were a mean age of 21, most were single and had never been married, were born in Australia and had a high level of education. Seven participants (25%) identified as belonging to the Lesbian, Gay, Bisexual and Transgendered (LGBT) community (including half of the participants with a history of MI).

Table 3. Participant Characteristics at Baseline

<table>
<thead>
<tr>
<th></th>
<th>Hx of MI (n=12)</th>
<th>No Hx of MI (n=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Age range</strong></td>
<td>19-25</td>
<td>18-25</td>
</tr>
<tr>
<td><strong>Age (Mean (SD))</strong></td>
<td>21.2 (2.1)</td>
<td>21.81 (2.3)</td>
</tr>
<tr>
<td><strong>Gender (n female (%))</strong></td>
<td>10 (83.3%)</td>
<td>10 (62.5%)</td>
</tr>
<tr>
<td><strong>LGBTI (n(%))</strong></td>
<td>6 (50%)</td>
<td>1 (6.3%)</td>
</tr>
<tr>
<td><strong>ATSI (n(%))</strong></td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td><strong>Marital status (n(%))</strong></td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>
Defacto 1 (8.3%)  1 (6.3%)
Never married / Single 11 (91.7%)  15 (93.8%)
**Born in Australia (n(%))**
- 9 (75%)  14 (87.5%)
**First language other than English (n(%))**
- 9 (75%)  14 (87.5%)
**Highest education (n(%))**
- High school 11-12 9 (75%)  9 (56.3%)
- University degree 3 (25%)  7 (43.8%)
**Employment status (n(%))**
- Employed (Full/part time, casual) 2 (16.7%)  4 (25%)
- Student 9 (75%)  9 (56.3%)
- Unemployed 0 (0%)  1 (6.3%)
- Other 1 (8.3%)  2 (12.5%)
**Health Risk Behaviors (n(%))**
- At risk – alcohol 5 (45.5%)  5 (33.3%)
- At risk – smoking 1 (14.3%)  2 (13.3%)
- At risk – diet 12 (100%)  15 (100%)
- At risk – physical activity 5 (45.5%)  6 (40%)
**LRI (Mean (SD))**
- 1.90 (0.57)  1.86 (0.92)
**PHQ4 (Mean (SD))**
- 5.67 (2.96)  2.60 (2.07)

Note: Hx = History; MI = Mental Illness, LGBT = Lesbian, Gay, Bisexual, Transsexual and Intersex; ATSI = Aboriginal and Torres Strait Islander; LRI = Lifestyle Risk Index; PhQ4 = 4 item Patient Health Questionnaire.

Both groups of participants described frequent mobile phone use. All participants used their mobile phone every day and most used it at least once every hour (Hx of MI: 75%, No Hx of MI: 75.1%). Most participants (Hx of MI: 91.7%, No Hx of MI: 78.6%) had also previously used their smartphone to look for health or medical information or track health and fitness data, with many reporting they did so on a weekly or daily basis (Hx of MI: 50%, No Hx of MI: 31.3%). The majority of participants also reported having a range of health apps installed on their smartphone, particularly exercise (Hx of MI: 66.7%, No Hx of MI: 56.3%), diet (Hx of MI: 100%, No Hx of MI: 71.4%), sleep (Hx of MI: 66.7%, No Hx of MI: 31.3%) and mood apps (Hx of MI: 50%, No Hx of MI: 12.5%). However, most participants with these apps
installed on their smartphone reported rarely using them (Hx of MI: 70.6%, No Hx of MI: 83.7%).

**Use of MyHealthPA**
As can be seen in Table 4 use of the MyHealthPA program varied widely among participants. Four participants with a history of MI (33.3%) and 2 participants without a history of MI (12.5%) never accessed the program. Out of a possible 56 days, participants accessed MyHealthPA on a mean of 3.82 days.

<table>
<thead>
<tr>
<th>Table 4. Participants’ use of MyHealthPA</th>
<th>Hx of MI (n=12)</th>
<th>No Hx of MI (n=16)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Number of days accessed</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MyHealthPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>3.17 (8.47)</td>
<td>4.31 (6.75)</td>
</tr>
<tr>
<td>Range</td>
<td>0-30</td>
<td>0-24</td>
</tr>
<tr>
<td><strong>Number of times access</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MyHealthPA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>6.42 (13.69)</td>
<td>7.13 (11.79)</td>
</tr>
<tr>
<td>Range</td>
<td>0-39</td>
<td>0-38</td>
</tr>
<tr>
<td><strong>Number of pages access</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>5.0 (11.49)</td>
<td>11.25 (14.59)</td>
</tr>
<tr>
<td>Range</td>
<td>0-41</td>
<td>0-44</td>
</tr>
<tr>
<td><strong>Number of diary entries</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>9.50 (20.59)</td>
<td>10.0 (16.56)</td>
</tr>
<tr>
<td>Range</td>
<td>0-54</td>
<td>0-54</td>
</tr>
<tr>
<td><strong>Number of goals set</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>0.25 (0.62)</td>
<td>0.75 (1.07)</td>
</tr>
<tr>
<td>Range</td>
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<td>0-3</td>
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</tbody>
</table>

Note: Hx = History

**Usability and acceptability**
Of the 12 participants who completed the end-of-treatment assessment, the majority (Hx of MI: 57.1%, No Hx of MI: 60%) reported the MyHealthPA program had above average usability (as indicated by a score of 68 or more on the SUS [30]). Specifically, as can be seen in Table 5, most agreed or strongly agreed that the program was easy to use, thought the functions of MyHealthPA were well integrated.
and most people with a history of mental illness thought they would learn to use the program very quickly and felt confident using the program. Similarly, most participants disagreed or strongly disagreed that they would need the support of a technical person to use MyHealthPA and that they needed to learn a lot of things before they could get going with the program. Additionally, 43% of participants with a history of MI, and 60% of people without a history of MI, thought MyHealthPA would help people to change their lifestyle behaviors. However, only 29% of participants with a history of MI and 40% of people without a history of MI agreed or strongly agreed that they would like to use the MyHealthPA program frequently and would recommend MyHealthPA to other young people.
Table 5. System Usability Scale (SUS)

<table>
<thead>
<tr>
<th></th>
<th>Hx of MI (n=7)</th>
<th>No hx of MI (n=5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I would like to use the MyHealthPA application frequently (Agree/Strongly Agree)</td>
<td>28.6%</td>
<td>40.0%</td>
</tr>
<tr>
<td>I found the MyHealthPA application unnecessarily complex (Disagree/Strongly Disagree)</td>
<td>42.9%</td>
<td>80.0%</td>
</tr>
<tr>
<td>MyHealthPA application was easy to use (Agree/Strongly Agree)</td>
<td>57.2%</td>
<td>60.0%</td>
</tr>
<tr>
<td>I would need the support of a technical person to be able to use MyHealthPA (Disagree/Strongly Disagree)</td>
<td>71.4%</td>
<td>70.0%</td>
</tr>
<tr>
<td>I found the various functions of MyHealthPA were well integrated (Agree/Strongly Agree)</td>
<td>57.1%</td>
<td>60.0%</td>
</tr>
<tr>
<td>I thought there was too much inconsistency in MyHealthPA (Disagree/Strongly Disagree)</td>
<td>42.9%</td>
<td>80.0%</td>
</tr>
<tr>
<td>I imagined that most people would learn to use MyHealthPA very quickly (Agree/Strongly Agree)</td>
<td>85.8%</td>
<td>40.0%</td>
</tr>
<tr>
<td>I found MyHealthPA cumbersome to use (Disagree/Strongly Disagree)</td>
<td>42.9%</td>
<td>40.0%</td>
</tr>
<tr>
<td>I felt very confident using MyHealthPA (Agree/Strongly Agree)</td>
<td>57.2%</td>
<td>40.0%</td>
</tr>
<tr>
<td>I needed to learn a lot of things before I could get going with MyHealthPA (Disagree/Strongly Disagree)</td>
<td>71.5%</td>
<td>80.0%</td>
</tr>
</tbody>
</table>

Note: Hx = History

Major barriers to using MyHealthPA identified by participants centered around remembering to use the program every day.

"I found it difficult to remember to use it every day – in fact I completely forgot about it until I got the email to do this survey. A phone app with daily reminders would be a good idea”.

Participants also mentioned that the need to login to the program each time (due to the website, rather than native application, format) was a barrier to use.
"Involved opening too many windows and logging in constantly".

Similarly, aspects of the program that participants identified as not working well including; the need to access the program via a web-browser on their mobile rather than simply opening a native app and the length of the adverse symptoms questionnaire. Additionally, one participant without a history of MI questioned the simplicity of the program.

"Maybe a bit TOO simple – didn’t really see the point in using it”.

Aspects of the program that participants identified as working well included the simple interface, how easy the program was to use and how quickly users could enter their information.

"Its easy to use, it works well on mobile, and doesn’t take much time”.

Participants also enjoyed being able to track and view their health behaviors and mood, and how they interacted over time, as highlighted by the following participant with a history of MI.

‘Could easily track my progress and see how my lifestyle had changed. It also made me aware of what I was eating, because I didn’t eat many vegetables or fruit before, but when I wrote it down I became aware of how unhealthy my lifestyle was. I found it interesting that when I started eating healthier and exercising a little bit more, my mood increased quite dramatically’.

Finally, the key changes to the MyHealthPA program participants’ recommended were converting the program to a native app format and allowing
continual login. Other suggestions included adding a calendar view of diary entries, allowing information from other health tracking apps to be integrated into MyHealthPA, providing more (but customizable) reminders to use the program, and providing extra information such as recipe and exercise ideas.

**Health Behavior Change**

As can be seen in Table 6, the greatest improvements were observed in participants’ fruit and vegetable consumption and physical activity, where both groups reported improvements in these behaviors between baseline and end-of-treatment, and baseline and follow-up. Some improvement in alcohol use among participants with a history of mental illness was observed, particularly between baseline and follow-up, however, participants with no history of mental illness actually reported a slight increase in the harmfulness of their alcohol use at both time points. Similarly, while no change in the number of cigarettes smoked per day was reported between baseline and end of treatment among participants with a history of MI, a slight increase at follow-up and among participants without a history of MI was reported. Participants with a history of MI reported improvement in psychological distress (as measured by the PhQ4) at end of treatment and follow-up.

Participants with a history of MI also maintained their LRI score at end of treatment and improved it by follow-up. On the other hand a slight increase in mean LRI among people without a history of MI was observed at end of treatment. Specifically, as can be seen in Table 7, one participant without a history of mental illness was no longer at risk for one behavior at end-of-treatment, while one had increased their risk behaviors by 2 at end of treatment. By follow-up three participants
with a history of MI were no longer at risk for 1 behavior they had previously been at risk for, one maintained their level of risk and 1 increased their risk by one behavior. The remaining participant without a history of MI reported maintaining their level of risk between baseline and follow-up.

Table 6. Change in health behavior and mood outcomes between baseline, end of treatment and follow-up.

<table>
<thead>
<tr>
<th>Outcome measures</th>
<th>Baseline to end-of-treatment</th>
<th>Baseline to follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hx MI (n=5)</td>
<td>No Hx MI (n=7)</td>
</tr>
<tr>
<td>AUDIT-C score</td>
<td>.00 (1.73)*</td>
<td>2.14 (1.86)</td>
</tr>
<tr>
<td>Cigarettes/day</td>
<td>0.00(0.00)*</td>
<td>1.50 (2.12)</td>
</tr>
<tr>
<td>Fruit and Veg /day</td>
<td>0.50 (1.00)*</td>
<td>1.71 (1.38)</td>
</tr>
<tr>
<td>IPAQ score</td>
<td>864.60 (1104.83)*</td>
<td>745.5 (1555.13)*</td>
</tr>
<tr>
<td>PHQ4</td>
<td>-.1.4 (4.51)*</td>
<td>0.29 (3.73)</td>
</tr>
<tr>
<td>LRI</td>
<td>0.00 (0.00)*</td>
<td>0.14 (0.89)</td>
</tr>
</tbody>
</table>

Note: * = change in desired direction or no change; Hx = History, MI = mental illness; No Hx MI = No history of mental illness; AUDIT-C = Alcohol Use Disorders Identification Test – consumption items; IPAQ = International Physical Activity Questionnaire; PHQ4 = 4 item Patient Health Questionnaire; LRI = Lifestyle Risk Index

Table 7. Change in Lifestyle Risk Index

<table>
<thead>
<tr>
<th>Change in risk behaviours</th>
<th>Baseline to end-of-treatment</th>
<th>Baseline to follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Hx MI</td>
<td>No Hx MI</td>
</tr>
<tr>
<td>Change of -1</td>
<td>0 (0%)</td>
<td>1 (14.3%)</td>
</tr>
<tr>
<td>No change</td>
<td>5 (100%)</td>
<td>5 (71.4%)</td>
</tr>
<tr>
<td>Change of +1</td>
<td>0% (n=0)</td>
<td>0% (n=0)</td>
</tr>
<tr>
<td>Change of + 2</td>
<td>0% (n=0)</td>
<td>1 (14.3%)</td>
</tr>
</tbody>
</table>

Note: Hx History, MI = mental illness;
Discussion

Principal Results
The results of the initial pilot study of the MyHealthPA program suggest that MyHealthPA is an acceptable, easy to use tool that may help people to reduce key health risk behaviors associated with CVD, especially people with MH problems. It is unclear why people with a history of MI may have reported more positive health behavior changes than people without a history of MI. Potentially these results indicate that while the FEDM may mean eHealth tools designed using this model are more acceptable and effective among people with MH problems, it may result in tools that are perceived to be too simple and are less effective among people without MH problems. However, when asked their opinions of the MyHealthPA program a slightly larger proportion of people without a history of MI rated the MyHealthPA as having above average usability. Promisingly participants with a history of MI also did not report increases in their psychological distress over the study period.

Limitations
The pilot study had a number of limitations, including the high rate of participant drop-out between the baseline, end-of-treatment, and follow-up assessments. Participants did not receive any incentives or compensation for completing each of the assessment points beyond receiving an extra entry into a draw to win an iPad. In previous research conducted by the research team that have achieved much higher follow-up rates an incentive of $20 to $50 per assessment has been offered to participants. Unfortunately, resource limitations meant that similar incentives were unable to be offered in the current pilot study. This lack of incentive may have been responsible for the low follow-up rates observed, highlighting the potential importance of incentives or compensation for participation in this kind of research. Additionally, a large proportion of participants never accessed
MyHealthPA, or accessed the program on only a few occasions, despite participants receiving reminders to access the program after 2 and 5 days of inactivity. For example out of a possible 56 days on which participants could have accessed the program, the maximum number of days the program was accessed was 30, with a mean of just under 4 days. As highlighted by participants this lower than anticipated, and desired, use of the program may have been influenced by the responsive website platform of the program. It is anticipated that converting the MyHealthPA program to a native app format may help to increase the frequency with which users want to access MyHealthPA. Other strategies to increase use may include building rewards into the program where users could earn stars or badges for recording behaviors or meeting set goals. Finally, these may need to be interpreted with caution as those participants recruited to the current pilot study may not be representative of the wider population of people with experience of MH problems. Participants with a history of mental illness in the current pilot were highly educated and mostly studying or employed. Despite these limitations these initial results are promising and further testing of the efficacy of the MyHealthPA program, including determining the optimal way in which to integrate this program into existing clinical and public health care, is warranted.

**Conclusions**

The aim of the current paper was to describe the formative research and process of planning that formed the development of the MyHealthPA program. MyHealthPA was developed to address the need for scalable, effective interventions to address CVD risk among people with MH problems that are of low burden to both clinicians and consumers. MyHealthPA targets the top four behavioral risk factors associated with CVD, which are also extremely common among people with MH
problems (smoking, alcohol misuse, physical inactivity and poor diet), while also addressing mood and the way in which mood and psychiatric symptoms might interact with these health behaviors. The program was designed to employ evidence-based techniques such as; self-monitoring and goal setting and addressing multiple health behaviors simultaneously [11]. It was also designed to overcome some of the potential obstacles to use of mobile health tools among people with MH problems by adopting Rotondi and colleagues’ flat explicit design model [20]. Additionally, the mobile-based platform of the program means that MyHealthPA could drastically extend the reach and scalability of CVD risk reduction programs for people with MH problems. It is hoped that subject to further testing in fully powered trials, and conversion to a native app format, that MyHealthPA could be accessed directly by people with MH problems who want to improve their health and/or used by health professionals to engage their patients with MH problems with the treatment of their physical health and prevention of CVD. This program could be particularly useful for consumers and health professionals in rural or remote communities where access to other treatment options is limited or in situations where waiting periods before and between appointments are particularly lengthy.

Overall, the MyHealthPA program represents an innovative approach to CVD risk reduction among people with MH problems. It appears that MyHealthPA is acceptable, easy to use, and potentially effective. A large scale clinical trial employing MyHealthPA in groups of people with MH problems is indicated.

Acknowledgements
This work was funded by Dr Thornton’s University of New South Wales Vice-Chancellor Post-Doctoral Fellowship. The authors would also like to acknowledge the work of Greg and his team at NetFront to develop the MyHealthPA program.
Conflicts of Interest
None declared

Abbreviations
CVD: Cardiovascular disease
MH: Mental health
CBT: Cognitive behavior therapy
FEDM: Flat explicit design model
Figure 1. Screen shots of the MyHealthPA program

"Success is the sum of small efforts, repeated day-in and day-out." -- Robert Collier
References:


