Uptake and adherence to an online intervention for cancer-related distress: older age is not a barrier to adherence but may be a barrier to uptake.
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Abstract:	**Purpose** While online interventions are increasingly explored as an alternative to therapist-based interventions for cancer-related distress, limitations to efficacy potentially include low uptake and adherence. Few predictors of uptake or adherence to online interventions have been consistently identified, particularly in cancer survivors. This study examined rates and predictors of uptake and adherence to Finding My Way, a RCT of an online intervention versus online attention-control for cancer-related distress. **Methods** Participants were adults with cancer treated with curative intent. Adherence was assessed by login frequency, duration, and activity level; analyses examined demographic, medical and psychological predictors of uptake and adherence. **Results** The study enrolled 191 adult (aged 26 - 94 years) survivors of multiple cancers. Uptake was highest for females and for individuals with ovarian (80%) and breast cancer

(49.8%), and lowest for those with melanoma (26.5%). Adherence was predicted by older age and control-group allocation. Baseline distress levels did not predict adherence. High adherers to the full intervention had better emotion regulation and quality of life than low adherers.

Conclusions

Uptake of online intervention varies according to age, gender and cancer type. While uptake was higher among younger individuals, once enrolled, older individuals were more likely to adhere to online interventions for cancer-related distress.

Implications for Cancer Survivors

More research on determinants of uptake of online interventions is warranted.

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Uptake and adherence to an online intervention for cancer-related distress: older age is not a barrier to adherence but may be a barrier to uptake.

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Abstract

Purpose

While online interventions are increasingly explored as an alternative to therapist-based interventions for cancer-related distress, limitations to efficacy potentially include low uptake and adherence. Few predictors of uptake or adherence to online interventions have been consistently identified, particularly in cancer survivors. This study examined rates and predictors of uptake and adherence to *Finding My Way*, a RCT of an online intervention versus online attention-control for cancer-related distress.

Methods

Participants were adults with cancer treated with curative intent. Adherence was assessed by login frequency, duration, and activity level; analyses examined demographic, medical and psychological predictors of uptake and adherence.

Results

The study enrolled 191 adult (aged 26 – 94 years) survivors of multiple cancers. Uptake was highest for females and for individuals with ovarian (80%) and breast cancer (49.8%), and lowest for those with melanoma (26.5%). Adherence was predicted by older age and control-group allocation. Baseline distress levels did not predict adherence. High adherers to the full intervention had better emotion regulation and quality of life than low adherers.

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Uptake of online intervention varies according to age, gender and cancer type. While uptake was higher among younger individuals, once enrolled, older individuals were more likely to adhere to online interventions for cancer-related distress.

Implications for Cancer Survivors

More research on determinants of uptake of online interventions is warranted.

Despite cancer-related distress affecting approximately 40% of people newly diagnosed with cancer [1], there is low acceptance of traditional face-to-face psychological therapy, with a recent meta-analysis suggesting that nearly half of all cancer patients and/or survivors do not take up face-to-face psychological interventions when offered [2]. There are significant barriers to accessing traditional therapist-based interventions, including limited availability [3], prohibitive travel distances [4], reluctance to disclose distress [3], and concerns about mental health stigma [3]. In response to these barriers, the use of online self-help interventions for cancer-related distress is being increasingly explored [5-14].

Online or web-based interventions consist of predominantly self-guided interactive programs designed to produce cognitive, affective and/or behavioural changes [15]. Typically based on empirically supported face-to-face treatments, most commonly cognitive behaviour therapy (CBT), these self-guided interventions require active engagement through the completion of web-based worksheets and activities [15]. Compared to educational (information only) programs which are considered therapeutically inactive, online self-guided interventions have a demonstrated efficacy across a range of psychological health conditions [16, 17], including distress arising from physical health conditions such as cancer [16-18].

While online interventions may help to overcome some of the barriers to uptake posed by face-to-face interventions, research on uptake (typically defined as the number of consenting participants, as a proportion of approached eligible individuals; e.g. [2, 19]) and adherence (the amount of an intervention an individual engages with or completes [20]) to online psychological interventions is sparse. A systematic review on barriers to uptake of *computerised* cognitive behavioural therapy found a median uptake of 38% (range 4-84%) and suggested differing recruitment strategies may explain varying levels of uptake [19]. While recently emerging reports on online interventions for the cancer population report on overall uptake rates (e.g. [7, 11, 14]), little research examines patient or intervention characteristics that differentiate or predict uptake.

Once taken up, low adherence can limit the efficacy of online interventions; non-completion in research studies of online interventions typically ranges from 30-60% [20, 21] and is as low as 1% [21] and 0.5% [22] for interventions offered in open access format. Low adherence has clear implications for research and clinical practice, as it can: (i) skew interpretations of efficacy if not clearly measured and reported, and (ii) moderate intervention outcomes, with longer exposure to an intervention yielding greater benefits [20, 23-26]. A recent systematic review of studies reporting adherence to online interventions for a variety of conditions found greater adherence was predicted by female gender, higher treatment expectancy, sufficient time, and personalised

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intervention content [27]. Mixed findings were obtained for the potential relationships between intervention adherence and age, baseline symptom severity and control group allocation. However, the majority of assessed variables did not predict adherence. Further, few studies have reported rates or predictors of adherence to online interventions among cancer populations specifically; one recent exception found no significant effect of age or baseline distress on adherence, but found user perceptions of usefulness, user-friendliness, and overall satisfaction predicted higher adherence to an online intervention for breast cancer survivors [28], while another found that provision of module referrals, higher perceived personal relevance and not having a partner was associated with higher adherence to an online intervention for early cancer survivors [13].

In sum, few studies to date have comprehensively summarised the characteristics / profile of users and non-users of web-based psychological interventions, both in terms of initial uptake of the program, and subsequent adherence, and very few have examined these characteristics specifically for cancer survivors. There are therefore currently knowledge gaps with regard to (i) rates and predictors of uptake to online interventions, particularly those aimed at cancer distress, (ii) the relationship between adherence to online interventions and those predictors previously identified as having mixed findings (e.g. age) and (iii) rates and predictors of adherence to online interventions aimed specifically at the cancer population.

To address these gaps we examined the predictors of uptake and adherence to an online intervention to reduce distress in cancer survivors offered as part of a randomised clinical trial comparing an interactive self-guided intervention versus an attention-control [5]. Specifically, the objectives of this analysis were (1) to quantify rates of uptake and adherence to the intervention (2) to identify characteristics that differed between those participating in and those declining the intervention and (3) to identify participant characteristics associated with higher adherence to the intervention.

Methods

The study was a randomised clinical trial examining a CBT-based online psychological intervention *Finding My Way* (FMW) versus attention-control aiming to reduce cancer-related distress in recently diagnosed individuals undergoing treatment with curative intent [5]. The full protocol outlining the methods, measures and planned analyses for the RCT have been published previously [5]. Below, methods relevant to the uptake and adherence sub-analysis are summarised.

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Participants

Participants were adult cancer patients receiving treatment with curative intent at one of seven

participating sites around Australia, recruited between 30th September 2013 and 16th November 2015.

Procedure

Ethical approval for this study was obtained from the relevant health authority ethics committees.

Participants either were actively recruited via cancer clinicians and research staff at seven participating sites

around Australia (six hospitals/cancer centres and one research register) or self-referred to the website in

response to promotion; all participants then accessed all aspects of the intervention online.

Intervention Conditions

FMW is a 6-module/6-week online, multi-media cognitive behavioural (CBT)-based intervention.

Participants in the intervention condition received access to all components of the intervention including

cognitive-behavioural worksheets / strategies, a private online note-taking feature, and mood monitoring and

management, while participants in the web-based control condition accessed only psycho-education and a

resources section (i.e. non-therapeutic components).

Measures

Uptake. Uptake was measured as the number of fully enrolled participants as a proportion of

approached eligible individuals, regardless of their level of adherence.

Adherence. Measures of adherence included website use indicators of *frequency*, *duration* and *activity*

level of participants, consistent with previous research [28, 29]. Activity level measures were the number of

modules completed and number of pages viewed overall; frequency measures were number of days the program

was accessed and total number of logins; while the duration measure was the total time logged in. High

adherence was defined as completion of 4-6 modules, considered a therapeutic dose as at least 66% or more of

the program was completed [12, 30, 31].

Participant characteristics. Demographic characteristics assessed included age, sex, marital status,

employment status, urban/rural residence, gross annual income, highest level of education, ethnicity, and

whether English was the participant's first language. Medical characteristics included type of cancer, time since

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diagnosis, and treatments received (chemotherapy, surgery, and radiotherapy). Some information on decliners was collected with individual consent, including age, sex, cancer type and reason for declining participation.

Psychological characteristics. *Cancer specific distress* was measured using the 17 item Posttraumatic Stress Scale-Self Report (PSS-SR: α = .91) [32] with scores ranging from 0-51 and higher scores indicating higher cancer-related distress. *General distress* was measured using the 21 item Depression Anxiety Stress Scales (DASS-21: α = .93), [33] with scores ranging from 0-42 and higher scores indicating greater negative affect *Quality of Life* was assessed using six functional subscales of the 30 item European Organisation for Research and Treatment of Cancer Quality of Life Core Questionnaire (EORTC QLQ-C30) [34] (global QoL, α = .88; physical, α = 82; social, α = .85; emotional, α =.83; role, α =.85; and cognitive functioning, α = .71), each with scores ranging from 0-100 and higher scores indicating higher functioning. *Coping* was measured using three internally reliable subscales of the mini-Mental Adjustment to Cancer Scale (mini-MAC) [35] (helplessness/hopelessness, α = 78; anxious preoccupation, α = .89; cognitive avoidance, α = .71), with higher summed scores indicating more negative coping. *Information-seeking preferences* were measured using the 8 item Miller Behavioral Style Scale [36], assessing 2 dimensions of information-seeking (monitoring: a greater tendency to seek information regarding threat-related cues; blunting: a greater tendency to distract from threat-related cues), with scores ranging from 0- 12 for each dimension and higher scores indicating more of that style. *Social support* was measured using the 19 item Medical Outcome Study Social Support Survey (MOSS: α = .97), [37] with scores ranging from 0- 76 and higher mean scores indicating greater available social support. Finally, emotion regulation was assessed using the 36 item *Difficulties in Emotion Regulation Scale* (α = .95) [38], with scores ranging from 0-144 and higher scores reflecting greater difficulties in emotional regulation, including sub-scale measures of non-acceptance, difficulty with goals, impulsiveness, difficulty with awareness, difficulty with strategies and difficulty with emotion clarity.

Health service use. The Health Service Utilisation Questionnaire [39] was used to generate a total health service use summary score, calculated by summing the total number of health services accessed including hospitals, GPs, hospital doctors, specialist doctors, and other health services (e.g. physiotherapist, massage therapist, naturopath) over the previous 12 months (scores ranged 0-17). Additional scores were utilised to independently examine hospital length of stay, number of visits to doctors including GPs, hospital doctors, and specialists (scores ranged 0-18), and number of other health professionals accessed (scores ranged 0-13).

Statistical Methods

All analyses were conducted using SPSS for Windows version 22.0 (SPSS Inc, Chicago, IL, USA). Differences between participant and decliner groups in variables with available data were tested using χ^2 tests of independence (gender, cancer type) and t-tests (age). Adherence was analysed in two ways. First, simultaneous multiple regression analyses were performed separately for each adherence measure to assess linear relationships between significantly correlated predictors and adherence measures. Variables were considered eligible to be entered as predictor for the multiple regression analysis of each respective adherence measure if they were found to have a significant partial correlation, controlling for group allocation, with that adherence measure in univariate analysis. Second, given differences were found between intervention and control groups in the number of modules completed, an exploratory analysis was performed in which group differences between low and high adherers (derived from number of modules completed) within control and intervention groups were analysed using χ^2 tests of independence for categorical predictors (e.g., gender, marital status) and t-tests for continuous predictors (e.g., age, baseline distress).

Results

Uptake

A total of 462 eligible individuals were identified as eligible to participate. Of these, 191 (41.3%) completed the enrolment process and participated in the study; 177 (38.3%) explicitly declined to participate; 81 (17.5%) did not enrol despite stated intentions, and reminders, to do so; and 13 (2.8%) initially consented but did not go on to complete baseline questionnaires/enrolment despite follow-up.

Participant and decliner differences

Participants most commonly identified as Australian (92%), and were female (84%), partnered (77%), tertiary educated (71%), living in urban areas (69%) and employed (63%); mean age was 53.86 years (SD = 10.30). Those who declined were also mostly female (73.6%,); mean age was 56.32 years (SD = 12.53, N = 229).

Comparison of decline rates by cancer type were as follows: 20% (1/5) for ovarian cancer, 45.5% (5/11) for lymphoma, 50.2% (122/243) for breast cancer, 60% (3/5) for prostate cancer, 66.6% (4/6) for lung cancer, 68.1% (32/47) for bowel cancer, 73.5% (50/68) for melanoma, and 63.5% (40/63) of all eligible approached patients with other cancer types (combined).

As presented in Table 1, decliners were significantly older than participants, $t(418) = 2.21$, $p = .028$, $d = 0.21$. Differences in uptake and decline existed between genders, with females more likely to participate than males χ^2

(1, n = 444) = 7.12, p = .008, phi = -.127. Differences also existed between cancer types, χ^2 (7, n = 448) = 19.25, p = .007, phi = .207; individuals with ovarian and breast cancer were more likely to participate compared to individuals with bowel cancer or melanoma. Within cancer types, individuals diagnosed with breast cancer were more likely, and those with melanoma less likely, to participate; rates of uptake did not differ significantly *within* any other cancer type.

[Insert Table 1 about here]

Reasons for declining participation

Of the 177 individuals who explicitly declined to participate, 37 individuals (20.9%) declined due to coping well enough on their own, 30 (17.0%) were 'not interested' in the program, 29 (16.4%) felt they did not have enough time, 22 (12.4%) were not comfortable using the internet, 17 (9.6%) felt that program participation was not a priority, 6 (3.4%) felt too unwell to participate, and 10 (5.7%) declined for other reasons (e.g. not wanting to think about cancer). Twenty-six (14.7%) returned an opt-out slip in response to a letter of invitation, thus reasons for decline could not be established for this group.

Adherence

Table 2 summarises the overall range in adherence, with usage ranging from completion of the full 6-module program (n=78; 40%) to no modules (n=20; 10.5%). This profile of usage differed by intervention-assignment: while intervention and control participants did not significantly differ on other measures of adherence, namely number of days logged in, total number of logins, total time logged in and total number of pages viewed, intervention participants completed significantly less modules overall than control participants, t(189) = -3.84, p < .001, d = 0.56, with a higher proportion of control participants completing the full program (52.6%) compared to intervention participants (28.7%). 117 (61.3%) individuals were categorised as 'high adherers' (accessed a therapeutic dose of 4 or more modules), whereas 74 (38.7%) were 'low adherers' (accessed 3 modules or less). Participants classified as high adherers on the basis of module completion were also higher in adherence across all other adherence measures, namely they demonstrated greater number of days logged in (M = 8. 18, SD = 3.02) than low adherers (M = 3.20, SD = 1.87), t(189) = -14.38, p < .001, d = 2.16, greater total number of logins (M = 10.41, SD = 4.70) than low adherers (M = 3.81, SD = 2.27), t(189) = -14.01, p < .001 d = 2.14, more total time logged in (M = 302.36, SD = 124.99) than low adherers (M = 113.60, SD = 58.90) t(189) = -14.95, p <.001, d = 2.14, and greater total number of pages viewed (M = 203.10, SD = 89.65) than low adherers (M = 71.64, SD = 34.94), t(189) = -16.71, p <.001, d = 2.44. After controlling for intervention and control group

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allocation by means of partial correlation analyses, the number of modules completed was significantly positively correlated with the number of days logged in ($r = .765$, $p < .001$), total number of logins (r $= .771$, $p < .001$), total time logged in ($r = .803775$, $p < .001$), and total pages viewed ($r = .877$, $p < .001$).

[Insert Table 2 about here]

Results for the multivariate analyses examining predictors of adherence measures are presented in Table 3. For *number of modules completed*, given that this measure of adherence was associated with control group membership, group membership was added as a predictor in step one along with age; to control for experimental group effects, the interaction between group membership and age was then entered in step 2. Group membership and age both made a significant unique contribution to module completion and the overall statistical regression model explained a small but significant 9.7% of variance ($R^2 = .097$, $F (2, 188) = 10.12$, $p = <.01$). However, in step 2 none of the variables including the interaction effect made a significant unique contribution; including the interaction in the model did not explain any further variance $R^2 = .097$, $F (3, 187) = 6.71$, $p = <.01$).

Only age made a significant unique contribution to *number of days logged in* to the program ($R^2 = .110$, $F (5, 185) = 4.582$, $p = <.01$); this was also true for *total number of log-ins* ($R^2 = .074$), F change $(2, 188) = 7.546$, $p = <.01$); *total time logged in* ($R^2 = .106$, $F (1, 187) = 7.377$, $p = <.01$); and *total number of pages viewed* ($R^2 = .094$, $F (4, 186) = 4.838$, $p = <.01$).

[Insert Table 3 about here]

Exploratory analyses of group differences in baseline characteristics between low and high adherers in control and intervention groups.

Exploratory analyses of differences in baseline characteristics between low and high adherers in control and intervention groups are shown in Table 4.

For the control group only, higher adherence was associated with living in a regional or rural, rather than urban, area, $\chi^2 (1, n = 97) = 9.62$, $p = .002$, *phi* = -.315.

In the experimental group only, low and high adherers differed significantly in *health service use*, with high adherers having lower total health service use, $t(92) = 2.33$, $p = .022$, $d = 0.48$, and accessing lower number of health professionals other than doctors, $t(92) = 2.33$, $p = .022$, $d = 0.48$, than low adherers. Low and high

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adherers also differed across two *quality of life* domains with high adherers having better emotional functioning $t(92) = -2.183$, $p = .032$, $d = 0.45$, and cognitive functioning, $t(92) = -2.020$, $p = .046$, $d = 0.41$, than low adherers. Finally, high adherers had less *difficulty regulating emotions* than low adherers, including less difficulty with emotion awareness, $t(92) = 2.239$, $p = .028$, $d = .46$), strategies, $t(92) = 2.507$, $p = .014$, $d = .51$), and emotion clarity, $t(92) = 3.559$, $p = .001$, $d = .74$), and less total difficulties in emotion regulation, $t(92) = 2.768$, $p = .007$, $d = .57$).

[Insert Table 4 about here]

Discussion

The present study, a detailed analysis of uptake and adherence to an online intervention to reduce distress in cancer survivors, shows that uptake of the online intervention varies according to age, gender and cancer type with older age being associated with lower uptake but higher adherence.

The study found uptake to an online intervention study at 41% of eligible individuals, higher than reported uptake of cancer patients to traditional therapist-administered face-to-face treatments (less than 25%) [40], indicating an increased reach; while uptake was lower than reported uptake of online psychological interventions for breast cancer survivors (e.g. [7, 11]), it was similar to uptake of a web-based intervention for survivors of heterogeneous cancer types [14]. Differences with higher uptake interventions may therefore reflect differences in uptake across cancer types (i.e. interventions reporting higher uptake recruited breast cancer patients only), or may indicate differences in recruitment processes (e.g. this trial did not require patients to meet a distress threshold which could have enriched the eligible population by those with the greater need for intervention), or reporting of eligible decliners (this trial was very stringent in reporting all individuals approached at research sites). Uptake was higher among females, and among individuals diagnosed with ovarian or breast cancer, which also corresponds with female gender, and lower among individuals diagnosed with melanoma or bowel cancer, with participants being slightly younger than those who declined. While higher uptake among females may be seen as consistent with broader research indicating women are more likely to engage in health-related behaviours than men [41], it is notable that in this case the difference between women and men was found only in uptake, and not adherence; that is, no differences were found in the extent to which women and men actually engaged with the program once enrolled. Higher uptake in those diagnosed with ovarian and breast cancer suggests either that the intervention had more relevance/appeal to ovarian and breast cancer patients, or that these individuals had higher motivation to participate for other reasons. In contrast, the

proportion of melanoma patients in the decliner group was more than twice the proportion of melanoma patients participating, suggesting less appeal or less overall motivation for these individuals to participate in the intervention. This may in part reflect that melanoma patients were sometimes approached at a very early stage of the cancer trajectory, meaning they were likely to have completed surgical treatment and were not engaged in ongoing treatments such as radiotherapy or chemotherapy which pose a burden in both time and potential morbidities. It should also be noted that melanoma participants in this study were recruited from a nationally recognised comprehensive cancer centre where, in contrast to other study sites, a range of additional psychological and supportive care services are routinely available.

Overall adherence to FMW was acceptable, with 60% completing a therapeutic dose of four or more modules and 40% completing all 6 modules. This is comparable to other studies of online interventions with completion rates of 40-70% [21, 29], and compares favourably with other online psychological interventions for cancer survivors, for example, one trial found 'continuous' usage to be 44.3%, with all weeks of the intervention logged in to by less than 10% of participants [28].

After controlling for group-allocation, this study found older age to be the most consistent predictor of adherence, with higher adherence predicted by age across all measures. While age has often correlated with adherence to online interventions, the direction of this relationship has varied with some studies showing younger age to be associated with higher adherence (e.g. [42]) and others showing that older age to be associated with higher adherence (e.g. [43]) [27]. Our group's recent systematic review suggested that adherence and age may fall on a normal-distribution curve, such that there is an optimum 'mid-age' range for adherence, as across studies middle-aged participants were found to have higher adherence than either younger or older adults [27]. However, the current findings appear to contradict this hypothesis, as 'older' age (ranging up to 94 years) was not only associated with higher number of logins, higher total time logged in and higher number of days logged in, (which in isolation might suggest older participants simply took longer to navigate the same amount of material as younger participants), but was also associated with greater number of modules completed and greater number of pages viewed, indicating that older participants truly engaged with more program content than younger participants. These results highlight the importance of measuring adherence in multiple ways and have significant implications for how adherence studies should be reported.

Reasons for higher adherence in older participants are unclear; while one might hypothesise that older participants have fewer time-commitments with respect to paid-employment, employment was not a significant

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predictor of adherence in multivariate analyses; similarly, while previous studies have suggested younger cancer patients experience higher levels of distress than older cancer patients [44], distress was not found to predict adherence in this study. There may therefore be other factors which reduce adherence to online interventions for younger cancer survivors, such as more competing demands [44]. Thus, while online interventions aim to increase reach of psychotherapeutic treatment, future research and design of psychotherapeutic interventions for cancer patients may need to address ways in which psychotherapeutic interventions can be most effectively designed for and provided to individuals with more competing commitments, potentially as part of a stepped care model [45]. Finally, it is important to note that, despite concerns that older age may mean less internet proficiency, older age did not appear to be a barrier to adherence to *Finding My Way*. However, as decliners were significantly older than participants, age may be a barrier to uptake of online interventions and preselect for the older participant who consider themselves adequately proficient with web use.

Prediction of adherence by control group membership was significant *only* for the 'number of modules completed' and not for total number of logins, number of pages viewed, number of days logged in or time logged in. Control group membership has been reported as a predictor of adherence of online interventions [24], although more recent reviews have found mixed evidence [27]; suggested reasons for adherence being predicted by control group membership included minimal demands on participants and the potential promise of receiving treatment for those in a waitlist control/delayed access condition [27]. In this study, due to the advantage of utilising an attention-control rather than waitlist control, higher adherence in the control condition appears likely to be due to minimal demands on participants in the control condition, given that it was not associated with the other adherence measures, and indicates that the control condition was appropriately pitched.

No psychological variables predicted adherence in multivariate analyses; however, there were differences within the intervention group only, namely high adherers had less difficulty regulating emotions, and better emotional and cognitive functioning. This suggests psychological predictors are of some importance in predicting adherence, but only in the context of a full intervention as opposed to a minimal-demand control. This may indicate a minimum level of emotion regulation and emotional functioning is required in order to appropriately process the psycho-oncological content (e.g. handling emotional distress, addressing the impact of a cancer diagnosis on identity and relationships) or to attend to the intervention. This finding adds to the literature on emotion regulation; while emotion regulation has been indicated as a moderator of anxiety and depressive symptoms [46], and as a maintenance factor in psychological disorder [47], it has not previously been examined

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as a potential predictor of adherence to online interventions [27]. Given that cognitive dysfunction is a commonly reported distressing and intrusive side-effect of cancer-treatment, the finding that those who are less impaired during treatment are better able to adhere is logical and this observation warrants further research.

In the experimental group only, high adherers also had lower self-reported baseline health service use than low adherers. While there is a dearth of research exploring health service use and adherence, one determinant of higher health service use is poor adjustment to illness [48].This could potentially indicate that high adherers had higher baseline adjustment to their illness; alternatively, those with higher health service use may have had their needs met elsewhere and may therefore have had less need for the online intervention. More research on health service use as a predictor of adherence to online interventions is needed to explore reasons for this finding.

While a number of key significant differences and predictors emerged in this analysis, it was also notable what was not found: consistent with the recent systematic review [27], adherence in the current study was not predicted by baseline distress, nor were the other psychological variables under investigation (coping, information seeking preferences). This is an important finding, as it indicates that even those who may be more severely distressed by their cancer can still adhere to these programs.

A key limitation of this study was underrepresentation of males, which may limit generalisability of results to males, as well as minimising the ability to assess gender differences in predictors of adherence. Additionally, due to the exploratory nature of analysis of group differences between low and high adherers in intervention and control groups, significance levels were not adjusted for multiple comparisons. On the other hand, a key strength of this study was the use of multiple adherence measures as recommended by previous research [27]; by evaluating *frequency*, *duration* and *activity* level of users engaged with the FMW program, this study provided a comprehensive view of the patterns of adherence across different measures, which is valuable given the emerging nature of this field of research. Another key strength was the use of a web-based attention-control, rather than waitlist-control, as recommended by previous research [27], which meant that prediction of adherence by control group membership could be attributed to the less complex nature of the control condition (i.e. minimal demands), rather than the promise of future treatment.

This study has important clinical implications for cancer survivors, as online intervention offers an important alternative means to address cancer-distress beginning in the early stages of the survivorship trajectory, with the potential to improve quality of life [1] and even improve subsequent medical outcomes, as reduced distress has been suggested to improve treatment adherence [49]. Therefore, the finding that neither baseline distress nor

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older age act as barriers to adhering to an online intervention in the early survivorship phase means that even distressed individuals and older individuals, who may be assumed to have less internet proficiency, can use and potentially benefit from online interventions. In contrast, younger survivors and those with poorer emotion regulation, emotional functioning, or cognitive functioning may need additional or alternative support to access psychological intervention given their more limited adherence to the online intervention.

As the number of cancer survivors increases, the need for efficacious web-based resources that meet their needs will become increasingly required. Greater understanding of who uses and benefits from online interventions will enable targeted provision of online psychotherapeutic interventions to those patients most likely to use and benefit from them, as part of a stepped care model as recommended in previous research on online interventions [45]. Patients who are less likely to benefit will then be able to be targeted by more intensive or therapist-assisted psychological support.

In conclusion, this study both supports and expands on the literature on predictors of uptake and adherence to online interventions. This study adopted a multiple adherence measure approach, thus providing a detailed view of predictors of adherence, and explored a more comprehensive range of psychological predictors than previous research. It is suggested that further research examines the influence of a broader range of predictors of uptake and adherence to online intervention for cancer distress.

Compliance with Ethical Standards

Conflict of Interest: Dr Lisa Beatty declares that she has no conflict of interest. Dr Emma Kemp declares that she has no conflict of interest. Ms Claire Binnion declares that she has no conflict of interest. Prof Jane Turner declares that she has no conflict of interest. Dr Donna Milne declares that she has no conflict of interest. Prof Phyllis Butow declares that she has no conflict of interest. Dr Sylvie Lambert declares that she has no conflict of interest. Prof Patsy Yates declares that she has no conflict of interest. Prof Desmond Yip declares that he has no conflict of interest. Prof Bogda Koczwara declares that she has no conflict of interest.

Ethical approval: All procedures in studies involving human participants were conducted in accordance with the ethical standards of the Southern Adelaide Clinical Human Research Ethics Committee, the Royal Brisbane and

Women's Hospital Human Research Ethics Committee, and the ACT Health Human Research Ethics

Committee, and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent: Informed consent was obtained from all individual participants in the study.

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Table 1. Age, gender and cancer type across participant and decliner groups, presented as mean (SD) or number (% participants/decliners).

	Participants (n = 191)	Decliners (n = 229-257)	p^a
Age	53.86 (10.30)	56.32 (12.53)	.028 (N = 420)
Female gender	160 (83.8)	185 (73.1)	.008 (N = 444)
Cancer type			.007 (N = 448)
- breast	121 (63.4)	122 (47.5)	
- melanoma	18 (9.4)	50 (19.5)	
- bowel	15 (7.9)	32 (12.5)	
- lung	2 (1.0)	4 (1.6)	
- lymphoma	6 (3.1)	5 (1.9)	
- ovarian	4 (2.1)	1 (0.4)	
- prostate	2 (1.0)	3 (1.2)	
- other	23 (12.0)	40 (15.6)	

[a] = p-values obtained from chi-square analyses for categorical variables and independent samples t-tests for continuous variables.

Table 2. Adherence (number of modules completed) by control and intervention group allocation, presented as number (%) or mean (SD).

	Control $N = 97$	Intervention $N = 94$	p^{a}	Total $N = 191$
0 modules	9 (9.28)	11 (11.70)		20 (10.47)
1 module	5 (5.15)	18 (19.15)	**.007****	23 (12.04)
2 modules	9 (9.28)	14 (14.89)		23 (12.04)
3 modules	3 (3.09)	5 (5.32)		8 (4.19)
4 modules	6 (6.19)	9 (9.57)		15 (7.85)
5 modules	14 (14.43)	10 (10.64)		24 (12.57
6 modules	51 (52.58)	27(28.72)		78 (40.84)
'High' adherence (completed ≥ 4 modules)	71 (73.20)	46 (48.94)	**.001****	117 (61.26)
Number of modules completed	4.45 (2.11)	3.29 (2.25)	**<.001**^**	
Number of days logged in	6.63 (3.63)	5.86 (3.50)	.115^	
Number of logins	8.33 (7.36)	4.73 (5.41)	.077^	
Total time logged in	227.15 (122.46)	231.37 (155.20)	.911^	
Number of pages viewed	139.86 (164.87)	73.72 (116.08)	.505^	

Note. ** = $p < 01$; ^ = inferential statistic obtained from analysis of transformed distribution; $^{\text{a}}$ = p-values obtained from chi-square analyses for categorical variables and independent samples t-tests for continuous variables.

Table 3. Linear regression analysis examining prediction of adherence measures by demographic variables, quality of life domains, and difficulties in emotion regulation.

Variable	β	R^2	F	p model
Number of modules completed				
Step 1				
Group allocation	**-.275****	.097	10.124	<.001
Age	**.158***			
Step 2				
Group allocation	.309	.097	6.716	<.001
Age	-.151			
Group allocation x age interaction	-.035			
Number of days logged in				
Age	**.221***			
Employment	-.054			
English first language	.131			
Social function	.049			
Total difficulties emotion regulation	-.059			
Total number of logins				
Age	**.245****	.074	7.546	<.001
Employment	-.049			
Total time logged in				
Age	**.252****	.106	7.377	< .001
Employment	-.036			
Total difficulties emotion regulation	-.130			
Total number of pages viewed				
Age	**.229****	.094	4.838	<.001
Stress^	-.018			
Emotion functioning	-.037			
Total difficulties emotion regulation	-.174			

Note: * $p > .05$, ** $p < .01$. All inferential statistics are reported from transformed distributions, but with directions adjusted to reflect direction of association with raw distribution.

Table 4. Baseline characteristics presented by low and high adherers within control and intervention groups.

Group allocation	Control			Intervention		
Assessed variable	Low adherers N = 26	High adherers N = 71	*p*	Low adherers N = 48	High adherers N = 46	*p*
Demographic						
Female	19 (73.08)	61(85.92)	.141	40 (83.33)	40 (86.96)	.622
Age	51.12 (11.88)	54.32 (9.71)	.178	52.79 (9.79)	55.83 (10.65)	.153
Urban location	24 (92.31)	42 (59.15)	**.002***	32 (66.67)	34 (73.91%)	.443
Married / partnered	21 (80.77)	49 (69.01)	.253	38 (95.00)	39 (84.78)	.479
Employed	18 (69.23)	47 (66.20)	.778	30 (62.50)	25 (54.35)	.423
Tertiary Education	17 (65.38)	53 (74.65)	.367	35 (72.92)	31 (67.39)	.558
Annual income < $35,000	14 (53.85)	40 (56.34)	.827	31 (64.58)	33 (71.74)	.457
Australian nationality	25(96.15)	63 (88.73)	.132	44 (91.67)	44 (95.65)	.187
English first language	26 (100.0)	68 (95.77)	.287	44 (91.67)	45 (97.82)	.183
Medical						
Type of cancer						
Breast	16 (61.54)	42 (59.15)	.493	32 (66.67)	31 (67.39)	.456
Melanoma	5 (19.23)	6(8.45)		3 (6.25)	4 (8.70)	
Other[b]	5 (19.23)	23(32.39)		13 (27.08)	11 (23.91)	
Treatment received						
Surgery	22 (84.62)	61 (85.92)	.872	42 (87.50)	43(93.48)	.325
Chemotherapy	19 (73.08)	56 (78.87)	.546	36 (75.00)	35(76.09)	.902
Radiotherapy	17 (65.38)	39 (54.93)	.356	28 (58.33)	24 (52.17)	.548
Days since diagnosis	134.08 (90.47)	145.35 (104.54)	.899^	139.57 (98.73)	136.52 (88.77)	.892^
Total health service use	5.54 (1.90)	6.27 (2.12)	.126	6.44 (1.75)	5.50 (2.15)	**.022***
Doctor visits	5.92 (2.62)	6.68 (3.13)	.278	6.71 (3.00)	6.00 (3.11)	.264
Number of other health professionals	2.50 (1.68)	3.14 (1.91)	.147^	3.04 (1.64)	2.35 (2.10)	**.020*^**
Hospital length of stay (days)	2.58 (2.79)	4.39 (4.57)	.135^	5.50 (5.56)	4.63 (4.92)	.620^
Psychological						
General distress	22.96 (19.54)	25.61 (18.47)	.336^	29.25 (19.63)	23.11 (17.92)	.157^
Cancer-specific distress	10.30 (8.16)	11.77 (8.52)	.493^	14.56 (11.51)	11.01 (8.61)	.147^
Global QOL	60.58 (26.72)	55.66 (19.63)	.397	49.85 (23.68)	57.47 (22.88)	.116
Physical function	85.09 (19.85)	80.38 (18.92)	.205^	79.58 (19.17)	79.98 (21.43)	.783^
Role function	67.31 (36.05)	65.02 (28.47)	.401^	62.15 (29.92)	58.15 (35.47)	.820^
Emotional function	72.12 (21.60)	69.00 (20.50)	.515	62.48 (21.09)	71.51 (18.92)	**.032***
Cognitive function	69.87 (26.67)	69.25 (25.14)	.663^	57.99 (28.14)	69.57 (27.96)	**.046*^**
Social function	59.62 (33.39)	63.85 (28.87)	.541	54.86 (32.24)	58.33 (31.38)	.598

Group allocation	Control			Intervention		
Assessed variable	Low adherers N = 26	High adherers N = 71	p	Low adherers N = 48	High adherers N = 46	p
Helplessness/hopelessness	10.77 (3.14)	11.52 (3.88)	.486^	12.40 (4.60)	10.90 (3.18)	.132^
Anxious preoccupation	17.88 (6.02)	18.36 (6.25)	.736	19.24 (6.87)	18.11 (5.83)	.394
Avoidance	9.54 (2.64)	8.93 (3.43)	.415	9.04 (3.16)	8.28 (2.96)	.233
Total social support	83.19 (14.20)	79.72 (16.00)	.290^	76.29 (16.90)	80.53 (15.18)	.199^
Monitoring	4.04 (1.51)	3.97 (1.88)	.871	3.46 (1.71)	3.52 (1.88)	.865
Blunting	2.12 (1.37)	1.82 (1.28)	.320	1.92 (1.30)	2.13 (1.24)	.418
Non-acceptance	14.73 (5.88)	14.04 (5.71)	.565^	14.44 (5.79)	12.82 (4.70)	.182^
Goals	14.31 (4.54)	14.66 (4.20)	.720	15.92 (4.32)	14.59 (3.71)	.114
Impulsiveness	12.04 (4.32)	11.85 (4.90)	.724^	13.15 (4.93)	11.65 (4.59)	.118^
Awareness	14.40 (3.54)	14.13 (4.68)	.789	15.59 (4.40)	13.75 (3.51)	**.028***
Strategies	17.50 (6.91)	17.25 (6.63)	.873	19.44 (6.13)	16.33 (5.86)	**.014***
Clarity	10.00 (3.92)	10.58 (3.49)	.364^	11.52 (4.05)	8.95 (2.81)	**<.001*^**
Total difficulties in emotion regulation	82.98 (23.43)	82.57 (23.96)	.940	89.93 (22.69)	78.08 (18.49)	**.007***

Note. * = $p < 05$ ^ = inferential statistic obtained from analysis of transformed distribution [a] = *p*-values obtained from chi-square analyses for categorical variables and independent samples *t*-tests for continuous variables. [b] = other includes bowel, lung, lymphoma, ovarian, prostate and unspecified.