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A randomised control trial and cost-consequence analysis to examine the effects of a print-based intervention supported by internet tools on the physical activity of UK cancer survivors

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ABSTRACT

Objective: The objective of this study was to evaluate the effectiveness of a print-based intervention supported by Internet tools at improving physical activity in cancer survivors compared with a standard letter recommendation. Prediagnosis physical activity and self-efficacy were hypothesised to predict physical activity improvement.

Study design: Waiting list randomised control trial and cost-consequence analysis.

Methods: Adult cancer survivors who could become physically active without prior medical approval were randomised to receive either a print-based intervention supported by Internet tools (intervention, $n = 104$) or a standard letter recommendation (control, $n = 103$). Physical activity was assessed at 12 weeks with maintenance assessed at 24 weeks in the intervention arm. The number needed to treat was calculated, and a cost-consequence analysis completed.

Results: Participants in receipt of a print-based intervention supported by Internet tools improved their physical activity by 36.9% over 12 weeks compared with 9.1% in the control arm. Physical activity was maintained at 24 weeks in the intervention arm. A total of 6.29 cancer survivors needed to receive the intervention for one cancer survivor to improve their physical activity over a standard letter recommendation. Intervention delivery cost £8.19 per person. Prediagnosis physical activity and self-efficacy did not predict physical activity improvement.

Conclusion: A print-based intervention supported by Internet tools offers a promising low-cost means to intervene to improve physical activity in cancer survivors.

The study was registered with the International Standard Randomised Controlled Trials Number registry (registration number: 66418871), and ethical approval was received from the University of Surrey (reference: UEC/2017/023/FHMS).

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Introduction

The benefits of physical activity for cancer survivors are well documented.[1] A recent systematic review of systematic reviews concludes that physical activity significantly improves clinical and functional outcomes in cancer survivors before treatment, during active treatment and after treatment regardless of cancer type.[1] Physical activity is safe[1,2] and should be recommended to all cancer survivors but with appropriate screening in place to identify those requiring medical support or guidance before increasing physical activity.[1] Despite the benefits of being active, physical activity typically decreases after a cancer diagnosis and may not increase without intervention.[3] Only 23% of cancer survivors in England are active to the aerobic physical activity guidelines.[4]

Cancer-specific physical activity services can be costly and are often inaccessible. There is a call for scalable cost-effective remote interventions to support cancer survivors to become physically active.[5] Cancer survivors across tumour sites and stages on the cancer continuum feel able and are interested in taking part in physical activities with a preference for home-based interventions[6] delivered via mail, Internet and video.[7] Cancer survivors want to become active on their own terms[8] with flexibility around other commitments,[6] and home-based interventions could help facilitate this.

The efficacy of broad-reach interventions in changing lifestyle behaviours is supported by systematic review evidence; however, the results for physical activity exclusive of other lifestyle behaviours are mixed.[5] Most offer one-to-one support either by phone, email or in-person,[5] increasing intervention costs and limiting reach. A positive trend is reported in physical activity and quality of life in the few examples of broad-reach interventions for cancer survivors without some element of one-to-one support.[9–13] Goode et al.[5] call for the development and evaluation, including cost-effectiveness, of broad-reach interventions using newer technologies with integrated modalities. A combined approach using print and Internet modalities has been recommended.[14]

Many interventions report a named theory, but few report on the application of theory to intervention development.[5,15] This is a common problem in the reporting of behaviour change interventions more broadly. Less than 30% of public health and healthcare behaviour change interventions describe their content using theory and behaviour change techniques (BCTs) in enough detail for replication.[16] The reporting of interventions should include detail of development, intervention components, related theoretical constructs and the BCTs used.[15,17]

Self-efficacy may be important in overcoming the barriers to physical activity faced by cancer survivors consistent with the general literature on health behaviour change.[18] Previous studies give mention to the importance of self-efficacy but do not include it as an outcome measure or a predictor of change.[11,12,19] Identifying as a physically active individual is also reported to be an indicator of physical activity in cancer survivors with those physically active before cancer diagnosis more likely to be so afterwards.[20]

A 2014 systematic review found no association between the time since diagnosis, treatment received or treatment status, tumour site, cancer stage or comorbidities with physical activity adherence in cancer survivors.[20] Clinical and demographic factors also do not predict improvement in health-related quality of life (HRQOL) in cancer survivors resulting from physical activity.[21] In the general population, females and those of older age are less likely to adhere to physical activity;[22] however, there is insufficient evidence to support this in cancer survivors.[20]

This article describes the development and evaluation of a print-based intervention supported by Internet tools called the Move More Pack. This study aims to investigate the effect of the Move More Pack on the physical activity, self-efficacy and HRQOL of cancer survivors over 24 weeks. As the evidence supports the unequivocal role of physical activity in improving clinical and functional outcomes in cancer survivors,[1] it is deemed unnecessary to assess additional outcomes.

It is hypothesised that use of the Move More Pack will increase physical activity and the proportion of cancer survivors who are classified as active over 12 weeks, with changes maintained at 24 weeks. Furthermore, it is hypothesised that self-efficacy and prediagnosis levels of physical activity will predict improvements in physical activity. The economics of the Move More Pack are assessed by a cost-consequence analysis, an approach suggested to be appropriate for public health interventions.[23]

Methods

This was a two-arm waiting list randomised control trial and cost-consequence analysis conducted in accordance with the Consolidated Standards of Reporting Trials.[24] The trial ran in accordance with the study protocol which has been published previously.[25] This study also included an embedded process evaluation, the results of which are reported separately.

The Move More Pack

UK charity Macmillan Cancer Support (Macmillan) developed a printed resource in 2011 called the Move More Pack that aimed to effect change in the physical activity of UK cancer survivors regardless of tumour site or cancer status. The principal investigator led the redevelopment of the Move More Pack in 2016 using guidance from the UK Medical Research Council on developing and evaluating complex interventions.[26]

The original Move More Pack was reviewed using the constructs of the Theory of Planned Behaviour (TPB),[27] the Social Cognitive Theory (SCT)[28] (as the most used causal theories of behaviour change)[29,30] and the Behaviour Change Technique Taxonomy, version 1 (BCTTv1)[31] to highlight areas for improvement. A group of six subject experts, representatives from Macmillan, and four cancer survivors developed the intervention content, which was awarded the National Health Service (NHS) England Information Standard.[32]

The resulting intervention consisted of a series of printed components and Internet tools (the Internet tools are available at www.macmillan.org.uk/BeActive; examples of the

printed components have been published previously)[25] and e-newsletters influenced by the stage of physical activity behaviour change model[33] with content tailored by prediagnosis levels of physical activity, age and gender. Supplementary file 1 presents detail of the Move More Pack (printed components and Internet tools) including the associated constructs of the SCT, the TPB and the BCTs used. Supplementary file 2 presents the components of the e-newsletters including the associated stage of physical activity behaviour change and the BCTs used.

Recruitment and randomisation

Participants were recruited by email invitation sent to 8910 UK cancer survivors on the 29th of March 2017, contacts held by Macmillan who had engaged with the charity within the previous six months. A separate invitation was also posted on the charity's Facebook page on the 3rd and 24th of April 2017 (it was not possible to assess the number of cancer survivors who viewed these Facebook posts).

In total, 1019 cancer survivors expressed an interest in the study and were informed that the study was investigating the impact of health promotion information on lifestyle behaviours; no specific reference was made to physical activity.

Participants were randomised by the principal investigator using simple randomisation to receive a standard letter recommendation in the mail (control) (supplementary file 3), or a letter (supplementary file 4) plus the Move More Pack (intervention) in the mail with signposting to the Internet tools. The study aimed to recruit 99 participants to each arm of the study; the sample size calculation is published elsewhere.[25]

Adult participants (aged 18 years and above) who could read English, provide consent and were computer and Internet literate with a working email account were included regardless of cancer status or type. Digital consent was obtained after guidance from the British Psychological Society ethics guidance for Internet-mediated research.[34]

The Move More Pack did not prescribe physical activity rather it aimed to empower cancer survivors to increase control over their physical activity behaviour and to be active on their own terms. The relevant safety information was sent as part of the standard letter recommendation and the Move More Pack in the mail to participants at the start of the study. The safety information had received the NHS Information Standard.[32] However, some cancer survivors require medical advice and approval before becoming more physically active. A screening questionnaire, based on guidance for exercise and cancer survivorship from the American College of Sports Medicine[35] and reviewed and approved by subject experts from Macmillan's physical activity team, identified and screened out those requiring medical guidance and approval before becoming physically active; the questions included within the screening questionnaire are published elsewhere.[25]

Participant information was collected on date of birth, gender, cancer type, time since diagnosis, treatment received, time since completion of treatment, response to treatment and ethnic group to assess baseline characteristics between arms. The structure of the questions used to obtain the additional participant information followed that used in a UK Department of Health survey.[4]

Procedures and assessment tools

Physical activity was assessed using the Godin Leisure-Time Exercise Questionnaire (GLTEQ)[36] a four-item questionnaire used previously with cancer survivors.[37] The GLTEQ provides a physical activity score to measure change and to categorise participants into insufficiently active (less than 14), moderately active (greater than 14 and less than 24) and active categories (greater than 24). Participants were asked to complete the GLTEQ twice at baseline:

1. To consider physical activity in a standard week before cancer diagnosis, to allow for the tailoring of the e-newsletters and to assess the predictive value of prediagnosis physical activity on physical activity improvement and
2. To consider physical activity in a standard week after diagnosis, as a baseline measure.

The cancer-specific 7-item Functional Assessment of Cancer Therapy questionnaire (FACT-G7) was used to assess HRQOL, providing a score from 1 (low HRQOL) to 28 (high HRQOL).[38]

Self-efficacy was assessed using the single-item measure 'On a scale of one–10 (1 = not at all confident and 10 = very confident), how confident are you that you will be physically active in situations such as the following: feeling tired, bad mood, not having the time, on vacation, bad weather?' based on a measure developed by Marcus et al.[39] used previously with cancer survivors.[40] Single-item assessment tools have been shown to perform just as well as multi-item assessment tools in measuring self-efficacy, as-well-as reducing burden on participant.[41]

The effectiveness of the Move More Pack at improving physical activity, self-efficacy and HRQOL was evaluated at 12 weeks and 24 weeks in both the intervention and control arms. The control arm received the Move More Pack at the 12-week time point. Participants in the control arm were asked, at 12 weeks, if they had previously used the Move More Pack with the data omitted from the study for those who had. Participants in the intervention arm continued to have access to the Internet tools between 12 weeks and 24 weeks. Data were collected between March and October 2017 using Qualtrics™ software and processed in accordance with the Data Protection Act.[42]

Data analysis

The data were analysed using intention-to-treat analysis with the last observation carried forward for missing data. Analysis of covariance (ANCOVA) assessed physical activity, self-efficacy and HRQOL improvement at 12 weeks between arms, controlling for the baseline observation of the outcome assessed and for age and gender when assessing the outcome of physical activity. The paired *t*-test was used to assess within-group changes.

Small improvements in physical activity can bring health benefits;[43] therefore, the impact of the Move More Pack on

physical activity improvement, or not, at 12 weeks was assessed using the two-proportion z-test. In addition, the number needed to treat was calculated. Binary logistic regression assessed the difference in the proportion of participants classified as active between groups at 12-weeks, controlling for baseline physical activity, age and gender.

The predictive value of prediagnosis physical activity and baseline self-efficacy resulting in physical activity improvement over 24 weeks in the intervention arm was assessed using regression analysis. All analyses were completed using SPSS™. A cost-consequence analysis was also conducted including only the costs for intervention delivery.

Results

The flow of participants through this study is presented in Fig. 1. There was an overrecruitment to the study with 104 in the intervention arm and 103 in the control arm, greater than the 99 planned per arm. A decision was made to include all participants because there was capacity to do so. No participants were removed from the waiting list control arm for previous use of the Move More Pack.

The baseline characteristics of the participants (Table 1) in the intervention and control arms were broadly similar; however, physical activity was higher in the control arm (Table 2). The baseline physical activity level for the trial sample as a whole was slightly higher than that of the general cancer population in England with 25.1% classified as active compared with 23.0%.[4] Data are not available on the physical activity levels of cancer survivors from across the UK.

The age profile of the trial sample is younger than that of the UK cancer population, with only 23.7% of participants older than 65 years compared with 63.0% of all UK cancer survivors.[44] The trial sample is overrepresentative of females with 73.9% compared with 59.1% in the UK cancer population.[44] Data are not available at a UK level on the prevalence of cancer in people from a black or minority ethnic group;[45] however, with 14% of people in England and Wales identified as black or from a minority ethnic group, it is possible that the trial sample is underrepresented with only 3.4%.[46] It is estimated that 27.6% of UK cancer survivors are living with breast cancer, 13.2% with prostate cancer and 11.6% with colorectal cancer.[45] This compares to 38.2%, 6.8% and 13.0% of the trial sample for breast, prostate and colorectal cancer, respectively.

All trial participants received the intervention as planned. Sadly, one person in the control arm died between the 12-week and 24-week time points not related to the intervention. A log of participant issues was maintained throughout the study; however, no issues or adverse events were reported. All participants were offered a debriefing phone call at the end of the study; however, no participants took up this offer.

Physical activity

The intervention arm reports a mean physical activity improvement score of 9.58 (standard deviation [*SD*] = 23.14) over 12 weeks, compared with 2.61 (*SD* = 24.10) in the control arm. ANCOVA controlling for baseline physical activity, age and gender reports a significant difference in the physical activity change score over 12 weeks between arms ($F(1, 202) = 4.34$, $P = 0.04$, $\eta_p^2 = 0.021$).

A statistically significant result was observed ($z = 2.30$, $P = 0.021$) in the proportion of the intervention arm improving physical activity over 12 weeks (n = 66 of 104, 63.5%) compared with the control arm (n = 49 of 103, 47.6%). The number needed to treat for one cancer survivor to increase their physical activity at 12 weeks was 6.29.

Binary logistical regression on the dichotomous variable of active or not (moderately active or insufficiently active) at 12 weeks controlling for baseline physical activity, age and gender reports a significant relationship between receipt of the Move More Pack and being classified as active ($\beta = 0.65$, $P = 0.04$, odds ratio [OR]: 1.91 [95% confidence interval {CI} = 1.02 to 3.57]). The percentage classified as active in the intervention arm was maintained from 12 weeks to 24 weeks, increasing slightly from 44.2% to 51.0% Fig. 2 and Fig. 3. The mean physical activity score was maintained in the intervention arm between 12 weeks and 24 weeks, increasing from 35.57 (*SD* = 23.71) to 40.84 (*SD* = 34.85). Regression analysis found neither self-efficacy nor prediagnosis physical activity to be a predictor of physical activity improvement over 24 weeks in the intervention arm (baseline self-efficacy: $\beta = -1.33$, $P = 0.36$, $R^2 = 0.008$; prediagnosis physical activity: $\beta = 0.59$, $P = 0.69$, $R^2 = 0.002$).

Self-efficacy

No differences are reported in self-efficacy between intervention and control arms ($F(1, 204) = 0.22$, $P = 0.64$, $\eta_p^2 = 0.001$) at 12 weeks. Within-group analysis reports a significant improvement in self-efficacy in the intervention arm over 12 weeks ($t(103) = 2.17$, *M* difference = 0.52, *SD* = 2.44, $P = 0.03$, $d = 0.21$), but not in the control arm ($t(102) = 0.94$, *M* difference = 0.23, *SD* = 2.51, $P = 0.35$, $d = 0.09$), with a further increase between 12 weeks and 24 weeks in the intervention arm although not significant ($t(103) = 1.88$, *M* difference 0.43, *SD* = 2.30, $P = 0.06$, $d = 0.18$). A significant improvement was observed in self-efficacy between baseline and 24 weeks in the intervention arm ($t(103) = 3.50$, *M* difference = 0.94, *SD* = 2.75, $P < 0.001$, $d = 0.34$).

An improvement in self-efficacy was observed after the introduction of the Move More Pack to the control arm, between 12 weeks and 24 weeks; however, this increase was not significant ($t(102) = 1.53$, *M* difference 0.39, *SD* = 2.58, $P = 0.13$, $d = 0.15$).

Health-related quality of life

No differences are reported in HRQOL between the intervention and control arms ($F(1,204) = 0.55$, $P = 0.46$, $\eta_p^2 = 0.003$) at 12 weeks. Within-group analysis reports a significant improvement in HRQOL in the intervention arm over 12 weeks ($t(103) = 2.78$, *M* difference = 0.95, *SD* = 3.49, $P = 0.006$, $d = 0.27$) with a further non-significant improvement between 12 weeks and 24 weeks ($t(103) = 1.35$, *M* difference = 0.52, SD = 3.92, $P = 0.18$, $d = 0.13$). A significant increase was

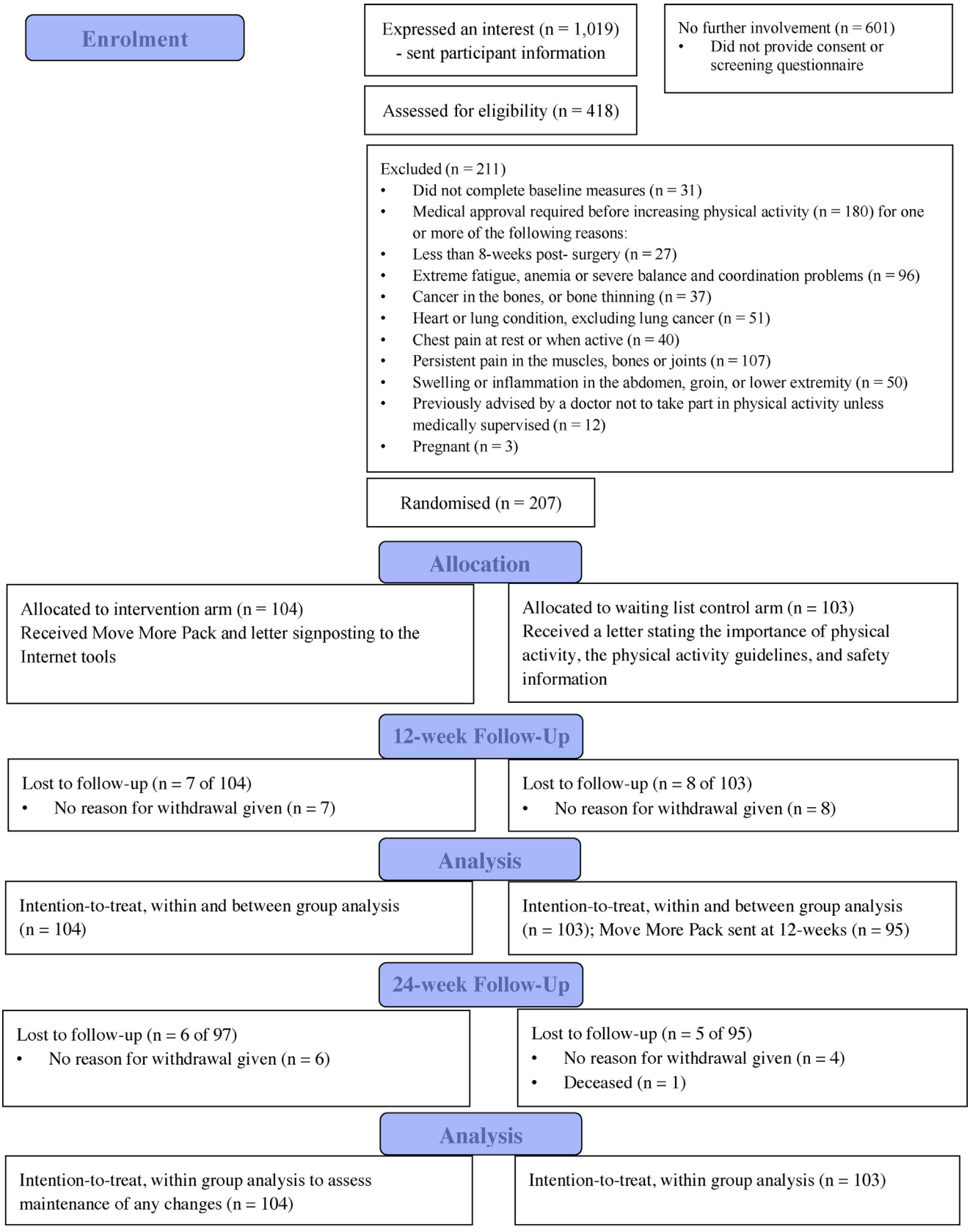

Fig. 1 – Flow of participants through the trial.

Table 1 – Participant baseline characteristics.

Characteristic	Intervention (n = 104)		Control (n = 103)		Overall (n = 207)	
	n	(%)	n	(%)	n	(%)
Gender						
Male	29	(27.9)	25	(24.3)	54	(26.1)
Female	75	(72.1)	78	(75.7)	153	(73.9)
Age in years						
0–44	15	(14.4)	15	(14.6)	30	(14.5)
45–64	68	(65.4)	60	(58.3)	128	(61.8)
65+	21	(20.2)	28	(27.2)	49	(23.7)
Ethnicity						
White British	96	(92.3)	94	(91.3)	190	(91.8)
Other white	4	(3.8)	6	(5.8)	10	(4.8)
Black or UK minority ethnic group	4	(3.8)	3	(2.9)	7	(3.4)
Cancer						
Breast	39	(37.5)	40	(38.8)	79	(38.2)
Colorectal	12	(11.5)	15	(14.6)	27	(13.0)
Prostate	8	(7.7)	6	(5.8)	14	(6.8)
Others – mixed	45	(43.3)	42	(40.8)	87	(42.0)
Time since diagnosis						
1 year or less	40	(38.5)	33	(32.0)	73	(35.3)
one–5 years	39	(37.5)	48	(46.6)	87	(42.0)
More than 5 years	11	(10.6)	13	(12.6)	24	(11.6)
No answer	14	(13.5)	9	(8.7)	23	(11.1)
Treatment status						
Treatment completed	69	(66.3)	70	(68.0)	139	(67.1)
In treatment	31	(29.8)	33	(32.0)	64	(30.9)
Not started treatment	3	(2.9)	0	(0.0)	3	(1.4)
No answer	1	(1.0)	0	(0.0)	1	(0.5)
Cancer status						
In remission or cured	55	(52.9)	65	(63.1)	120	(58.0)
Treated but cancer still present	13	(12.5)	15	(14.6)	28	(13.5)
Cancer has come back since treatment	6	(5.8)	5	(4.9)	11	(5.3)
Cancer present, no treatment received	3	(2.9)	0	(0.0)	3	(1.4)
Not known	27	(26.0)	18	(17.5)	45	(21.7)

Table 2 – Change in physical activity, self-efficacy and health-related quality of life scores [mean (standard deviation)].

	Intervention			Control		
	Baseline	12 weeks	24 weeks	Baseline	12 weeks[a]	24 weeks
Physical activity score	25.99 (19.37)	35.57 (23.71)[b,c]	40.84 (34.85)[d]	28.70 (24.05)	31.31 (22.65)	39.49 (28.97)[e]
Self-efficacy	4.89 (2.44)	5.41 (2.59)[f]	5.84 (2.66)[d]	5.20 (2.67)	5.44 (2.55)	5.83 (2.39)
Health-related quality of life	16.85 (4.70)	17.80 (5.16)[g]	18.32 (5.26)[d]	17.24 (5.22)	18.46 (4.99)[g]	19.00 (5.27)

[a] The Move More Pack (intervention) was introduced to the control arm participants at 12 weeks.
[b] Significant difference between intervention and control arms – P<0.05.
[c] Significant difference within group from baseline to 12 weeks – P <0.001.
[d] Significant difference within group from baseline to 24 weeks (assessment in the intervention arm only) – P <0.001.
[e] Significant difference within group from 12 weeks to 24 weeks – P <0.001.
[f] Significant difference within group from baseline to 12 weeks – P <0.05.
[g] Significant difference within group from baseline to 12 weeks – P <0.01.

observed in HRQOL from baseline to 24 weeks in the intervention arm ($t(103) = 3.66$, M difference = 1.47, $SD = 4.11$, $P < 0.001$, $d = 0.36$).

HRQOL significantly improved in the control arm from baseline to 12 weeks ($t(102) = 3.00$, M difference = 1.22, $SD = 4.11$, $P = 0.003$, $d = 0.30$). After the introduction of the Move More Pack to the control arm at 12 weeks, a non-significant HRQOL improvement of 0.54 ($SD = 3.20$) was observed ($t(102) = 1.73$, $P = 0.09$, $d = 0.17$) between 12 weeks and 24 weeks.

Cost-consequence analysis

The costs for the Move More Pack (intervention) and the standard letter recommendation (control) are presented in Table 3. The cost-consequence analysis is presented for a 12-week period. The 12-week outcomes for physical activity, self-efficacy and HRQOL are presented in Table 2.

The cost of delivery of the Move More Pack was £8.19 per person, 8.6 times higher than the cost of the standard letter recommendation at £0.95. A total of 6.29 cancer survivors need

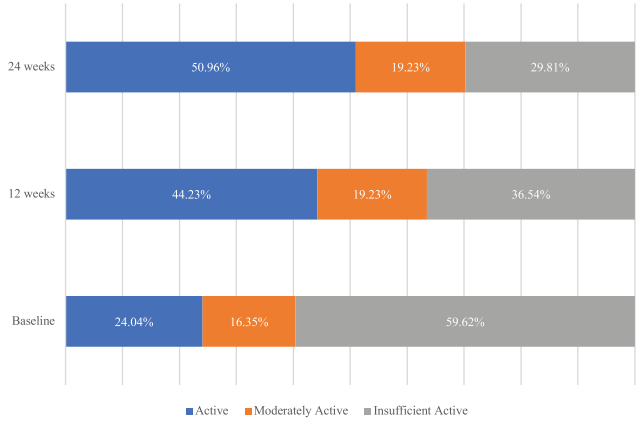

Fig. 2 – Physical activity classification in the intervention arm at baseline, 12 weeks and 24 weeks.

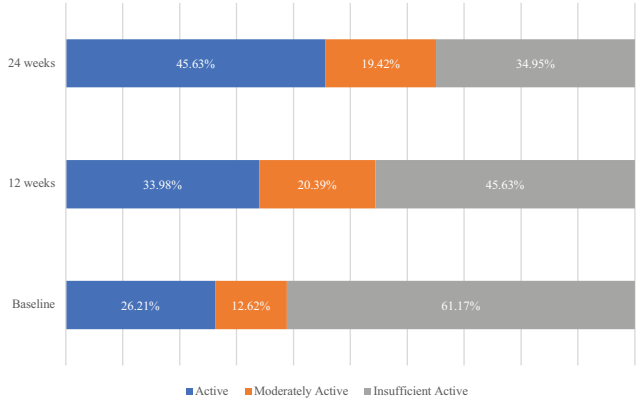

Fig. 3 – Physical activity classification in the control arm at baseline, 12 weeks, and 24 weeks (intervention introduced at 12-weeks).

to receive the Move More Pack for one cancer survivor to improve their physical activity over the standard letter recommendation at 12 weeks, a cost of £45.54 per physical activity improvement.

Discussion

This study investigates the effectiveness of the Move More Pack at increasing the physical activity, self-efficacy, and HRQOL of UK cancer survivors. The trial sample is slightly more active at baseline than the population of cancer survivors in England (as a proxy measure of the physical activity of UK cancer survivors); however, it is noted that the results are not age and gender standardised. It is acknowledged that the GLTEQ may not be mapped directly onto the UK physical activity guidelines; however, it does provide a useful comparison.

The higher-than-expected level of baseline physical activity may be explained by the recruitment of cancer survivors through Macmillan. It may be that those engaging with Macmillan are more likely to adopt healthy lifestyle behaviours and be more physically active. It may also be explained by the younger age profile of the sample when compared with the UK cancer population which could also be indicative of those engaging with Macmillan.

Table 3 – Intervention and control costs.

	Cost per unit	Unit	Total
Intervention – The Move More Pack			
Print – Move More Pack[a]	£5.00	104	£520.00
Print – cover letter[b]	£0.07 per page	104 (two-pages)	£14.56
Postage	£1.87	104	£194.48
Website hosting[c]	£40.81 per month	3	£122.43
Total			£851.47
Estimated cost per person			£8.19
Control – standard letter recommendation			
Print – letter[b]	£0.07	104 (four-pages)	£29.12
Postage	£0.67	104	£69.68
Total			£98.80
Estimated cost per person			£0.95

[a] Source: Costs for the Move More Pack printed components were taken from the cost of Macmillan's services fact sheet (2017).[48]
[b] The letters sent to the control and intervention arm participants were printed A4 in colour. The print costs for the letter in the control arm were calculated for 104 units to allow direct comparison to the intervention arm.
[c] The Internet tools were included on the Macmillan website hosted by Microsoft Azure™. The costs were estimated for a basic service to create Web pages.[49] The e-newsletters were created and sent by the principal investigator.

The screening out of 180 interested participants may have resulted in those less active being inadvertently removed from the study, leaving a higher proportion of active participants. This is an important finding in itself because the need to obtain medical approval before becoming active could create a barrier to physical activity. It should be understood that the results are discussed in the context of cancer survivors who can be active without prior medical approval.

Of the most common cancer types, the trial sample has an overrepresentation of breast cancer survivors and an underrepresentation of prostate cancer survivors, with a comparable representation of colorectal cancer survivors to the UK cancer population. Again, this may reflect the cancer survivors engaging with Macmillan. For these reasons, the generalisability of the findings to the UK cancer population should be approached with caution.

The main outcomes

Any improvement in physical activity is positive.[43] Those in receipt of the Move More Pack are 33% more likely to improve their physical activity over a standard letter recommendation. This study suggests that the Move More Pack significantly increases the likelihood of being classified as active at 12 weeks over a standard letter recommendation by an OR of 1.91. These findings are in support of the study by Short et al.[11] who report an OR of 1.73 for meeting the aerobic physical activity guidelines from receipt of a printed physical activity workbook over a standard letter recommendation.

Physical activity improvement from the Move More Pack over a standard letter recommendation is significant when controlling for baseline physical activity, age and gender, supporting the findings of Vallance et al.[12] A more pronounced difference in physical activity improvement may have been observed if the control group had consisted of usual care rather than a standard letter recommendation. The standard letter recommendation was followed by a 9.1% increase in physical activity over 12 weeks in support of the findings of Short et al.[11] and Vallance et al.,[12] compared with a 36.9% increase from the Move More Pack. This suggests that a simple letter may be enough to result in small increases in physical activity, but this requires further investigation.

It was hypothesised that those with greater prediagnosis physical activity levels and with higher baseline self-efficacy would be more likely to improve physical activity after receipt of the Move More Pack. This was not the case, in contrast to the findings from Pinto et al.[19]

A positive trend is reported in self-efficacy over 12 weeks with a greater increase from the Move More Pack than the standard letter recommendation; however, no differences are reported between groups. It is favourable to note that self-efficacy continued to rise between 12 weeks and 24 weeks in those receiving the Move More Pack. The improvements in self-efficacy are small, and as a secondary outcome, this study is not powered to pick up the significance of such small increases.

Similar results are seen for HRQOL with a positive trend reported from receipt of the Move More Pack and also a standard letter recommendation but with no significant difference between groups. Vallance et al.[12] report a 1.4% improvement in HRQOL from receipt of a standard recommendation, compared with a 5.8% improvement from a printed physical activity workbook in combination with a pedometer. This study reports comparable improvements in HRQOL in those receiving the Move More Pack of 5.6%; however, unexpectedly, the standard letter recommendation was followed by a 7.1% improvement in HRQOL over 12 weeks. The comparable HRQOL scores at 12 weeks may be due to a ceiling effect resulting from the already-moderate HRQOL scores observed at baseline. The moderate baseline HRQOL scores may be indicative of the cancer survivors engaging with Macmillan.

Intervention delivery costs £8.19 per person, offering a potentially low-cost intervention to improve physical activity in UK cancer survivors. Only Short et al.[47] report the costs associated with their print-based intervention, but these were related to intervention development rather than delivery, so direct comparison is not possible.

Study limitations

This study is not without its limitations. Although the sample is of a similar size to other studies in this field,[11,12] a larger sample would help identify small changes in HRQOL and self-efficacy. This study would have benefited from a third arm being usual care.

It is acknowledged that of the 8910 cancer survivors informed of the research study, only 1019 expressed an interest and only 418 completed a consent form, potentially biasing the sample to only those interested in research studies. Furthermore, it is possible that only those with an interest in lifestyle behaviour change consented to take part. The screening out of 180 interested participants, as previously mentioned, may have resulted in a more active sample. The limitations of recruiting the sample through Macmillan have already been highlighted.

The use of an objective measure of physical activity may have been preferable; however, this would have introduced an additional BCT not included within the intervention. It is also acknowledged that use of a single-item measure to assess self-efficacy may be open to participant interpretation which could result in bias.

Finally, the follow-up of participants could have been extended to a longer time frame, for example 12 months; however, this research was conducted as part of a PhD thesis and an extended time frame was unfortunately not possible in this research study.

Despite these limitations, it can be said with some confidence that the findings are generalisable to those engaging with Macmillan but generalisability to the broader UK cancer population cannot be confirmed. To date, this study offers the best available evidence to support a print-based intervention supported by Internet tools to potentially increase physical activity in UK cancer survivors.

Implications for future research

This study suggests that print-based interventions supported by Internet tools offer a potentially promising means to improve physical activity, over 24 weeks, in UK cancer survivors who are able to become physically active without prior medical approval and who have Internet and email capability. This area warrants further investigation. It is acknowledged that not all cancer survivors will have Internet and email capability and therefore alternative interventions to support this population should also be investigated. Research and evaluation should continue, using the best available designs, to understand the impact of print-based interventions supported by Internet tools on the physical activity, self-efficacy and HRQOL of cancer survivors over 12 months or more with larger sample sizes to identify small changes.

Conclusion

The Move More Pack significantly increases physical activity over a standard letter recommendation at 12 weeks but not self-efficacy or HRQOL. Prediagnosis physical activity levels and baseline self-efficacy do not predict physical activity improvement from use of the Move More Pack. Print-based interventions supported by Internet tools offers a potentially promising low-cost means to intervene to improve physical activity in cancer survivors and warrant further investigation.

Author statements

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Ethical approval

The study was registered with the ISRCTN (registration number: 66418871), and ethical approval was received from the University of Surrey (reference: UEC/2017/023/FHMS).

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Competing interests

The principal investigator is a former member of staff of Macmillan and led the design and redevelopment of the Move More Pack in 2016. The principal investigator ceased employment with the charity in April 2017. The relationship between the principal investigator and Macmillan after April 2017 has continued in relation to this research project only. No other conflicts of interest are reported.

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Appendix A. Supplementary data

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