The effectiveness of an online multimodal intervention for mental health promotion: A randomised controlled trial

Geraldine Przybylko (geraldineprzybylko@adventist.org.au)
Avondale College of Higher Education https://orcid.org/0000-0003-1383-5392

Darren Morton
Avondale College of Higher Education

Lillian Kent
Avondale College of Higher Education

Jason Morton
Avondale College of Higher Education

Jason Hinze
Avondale College of Higher Education

Peter Beamish
Avondale College of Higher Education

Melanie Renfrew
Avondale College of Higher Education

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Abstract

Introduction: There is an urgent need for efficacious interventions to combat the global mental health crisis, and mental health promotion and primary preventive approaches are paramount.

Objective: This study examined whether an online multimodal intervention that incorporates evidence-based strategies from the disciplines of Lifestyle Medicine and Positive Psychology improved measures of mental health and emotional wellness.

Methods: 425 adults (68.8% females, aged 46.5 ± 15.6) from Australia and New Zealand were randomised to an intervention or control group. The intervention group participated in a ten-week online multimodal intervention. Measures of mental health and emotional wellness were taken at baseline (Week 1), post-intervention (Week 12), and 12 weeks post-intervention (Week 24). The control group completed the same assessments.

Results: The intervention group experienced significant improvements from Week 1 to 12 in: mental health (10%, $p < 0.001$, $d = 0.50$) and vitality (22%, $p < 0.001$, $d = 0.54$) subscales of the Short Form Survey (SF-36); depression (-42%, $p < 0.001$, $d = 0.48$), anxiety (-38%, $p < 0.001$, $d = 0.39$) and stress (-31%, $p < 0.001$, $d = 0.52$) subscales of the Depression, Anxiety and Stress Scale (DASS-21); and life satisfaction (8%, $p < 0.001$, $d = 0.48$) as measured by the Satisfaction With Life Scale (SWLS).The control group experienced significant improvements only in the mental health (3%, $p = 0.028$, $d = 0.16$) subscale of the SF-36, and the stress subscale (-9%, $p = 0.038$, $d = 0.15$) of the DASS-21. The changes in the intervention group were significantly greater ($p < 0.001$) than the control group for all measures. Improvements in the outcome measures were generally sustained for the intervention group at 12 weeks post-intervention.

Conclusion: The online multimodal intervention improved measures of mental health and emotional wellness suggesting that such interventions may be useful for mental health promotion and prevention.

Trial registration: The Australian New Zealand Clinical Trials Registry

ACTRN12619000993190. Registered on 12 July 2019 (Retrospectively registered).

The ANZCTRN is part of the WHO Primary Registries.

Background

Common mental health disorders have reached epidemic proportions worldwide.[1] In the United States (U.S.), the burgeoning costs of mental disorders constituent the most costly medical condition, amounting to 201 billion U.S. dollars annually, which surpasses heart conditions (147 billion U.S. dollars), trauma (143 billion U.S. dollars) and cancer (122 billion U.S. dollars).[2] The current paradigm for the frontline treatment of affective disorders centres on pharmacological intervention. Antidepressant usage has doubled over the past decade in the United Kingdom;[3] is now ranked in the top three most

commonly used therapeutic drug classes in the U.S.;[4] and is the most commonly used psychotropic medication in Australia.[5] Despite this increase, the incidence of depression continues to escalate.[5–7]

This has led to repeated calls to address mental health on a population-level using a more integrative approach that includes non-pharmacological strategies such as lifestyle interventions, mental health promotion, education programs and psychological therapies.[5, 7–12] Further, in a recent article in BMC Public Health,[13] a call was made to encourage a greater focus on primary prevention initiatives to reduce the burden of mental health disorders. Mental health promotion and prevention initiatives may enhance the mental health of healthy populations and serve as a protective buffer against mental illness.[14]

Over the past few decades, numerous evidence-based strategies for improving mental health and emotional wellness have emerged in the literature underpinning the disciplines of “Lifestyle Medicine” and “Positive Psychology”.[15–18] Lifestyle Medicine has historically focused on the prevention, management and reversal of chronic diseases through the promotion of exercise, a healthy diet, and sleep,[16, 19–26] however, there is growing evidence that these lifestyle practices also have positive benefits on mental health.[9, 27–31] For example, considerable literature is showing that dietary interventions can be used as an effective treatment strategy for depression.[32] Further, a meta-analysis has shown that exercise is beneficial for mental health.[33] The causal relationship between insomnia and depression[34] is well established; and quality sleep is known to be paramount to good physical and mental health.[35, 36]

Positive Psychology focuses on pathways to promote human flourishing through exercises such as practicing gratitude, goal training, activating signature strengths, engaging in service activities and nurturing relationships. [37–40] The conclusion of two meta-analyses was that Positive Psychology interventions significantly enhance emotional wellbeing and decrease depressive symptoms.[41, 42]

Lifestyle Medicine and Positive Psychology strategies have demonstrated efficacy for enhancing mental health and emotional wellness, however, they are often used in isolation. Interestingly, practitioners have been encouraged to prescribe multiple Positive Psychology strategies in a “shotgun approach”, rather than using a single strategy, as it may be more efficacious for their clients. [41] Additionally, the potential “compounding effects” of combining diet and exercise together, warrants further investigation of a more integrated approach using multiple lifestyle modifications.[32]

Advances in online technology presents an opportunity to provide mental health promotion and primary prevention strategies that are easily accessible, available population-wide, overcome barriers with face-to-face interventions and the stigma of mental health disorders.[43–46] Online interventions can also provide low-cost solutions for dissemination on a population-level.

This study investigated the effectiveness of a ten-week online multimodal intervention, incorporating both Lifestyle Medicine and Positive Psychology strategies, for improving the mental health and emotional

wellness of a community-based cohort. It was hypothesised that using an array of evidence-based strategies from both disciplines may realise a “compounding effect” on these outcomes.

Method

Design and Participants

The study used a non-blinded randomised controlled design. The treatment group participated in a ten-week intervention consisting of themed weekly sessions (see Table 1). Measurements of mental health and emotional wellness (mental health, vitality, depression, anxiety, stress and life satisfaction) were taken at baseline (Week 1), post-intervention (Week 12) and 12 weeks post-intervention (Week 24) (see Fig. 1). The control group underwent the same measurements at times corresponding to the intervention group. The intervention was made freely available to the control group at the completion of the study. Data was collected from July 2017 to February 2018 and analysed in 2018 and 2019. All procedures involving human subjects were approved by Avondale Human Research Ethics Committee [project number 2017:13]. The trial protocol is registered at The Australian New Zealand Clinical Trials Registry (ACTRN12619000993190).

Table 1
Weekly topics and challenges for the Live More Project Intervention

Week / Topic	Daily Challenge	Weekly Challenge
1. Language and Emotion	Offer a genuine compliment.	Memorise an inspirational text or saying.
2. Posture and Regular Physical Activity	Spend 30 minutes of moderate exercise or 10,000 steps.	20 minutes of guided resistance exercises.
3. Sunlight and Natural Environments	Spend 30 minutes in an uplifting natural environment.	Experience a sunrise.
4. Social Connections	Do something intentional to show you care.	Forgive someone who has hurt you.
5. Positive Outlook	Spend 15 minutes to reflect on three things that went well.	Write a letter of gratitude to someone and share it with them.
6. Diet and the Gut Health Connection	Eat eight serves of plant-based food.	Prepare a high-fibre, plant-based meal with one or more friends.
7. Rest	Spend eight hours in bed without a device.	Spend an evening by firelight.
8. Stress Management	Spend 15 minutes in a quiet place, relaxing and being mindful of surroundings.	Take a day off work and a digital Sabbath (going “off-line” for 24 hours to recharge).
9. Signature Strengths and Serving Smart	Perform a random act of kindness.	Use signature strength to perform an act of service.
10. Flourishing	Continue challenges found to be helpful.	Continue challenges found to be helpful.

The participants comprised of self-selected men and women from Australia and New Zealand who were recruited through a faith-based organisation. The study was advertised in the faith-based organisation’s internal communication channels including bulletins and magazines. The advertising materials did not target a clinical population. Instead, the intervention was promoted as an “emotional wellness” program. Inclusion criteria for participation in the study included: 18 years and older; fluent in English; and email and internet access. Before randomisation, the subjects agreed to participate in either arm of the study. The participants were then randomised, non-blinded into the intervention or control group by a non-member of the research team using computer random number generation. Participants were then notified of their group allocation and were required to complete their enrolment and submit their informed consent.

Intervention

The intervention, referred to as “The Live More Project” or “The Lift Project”,[47, 48] is a ten-week program that integrates strategies from the Lifestyle Medicine and Positive Psychology literature. Underpinning the intervention is the Theory of Planned Behaviour (TPB) that aimed to facilitate behavioural change through three key areas: a shift in attitude towards emotional wellness through education; a change in perceived norms by promoting social engagement; and an increase of perceived control by encouraging the participants to achieve weekly challenges. [49]

The intervention used an experiential pedagogical framework of Learn, Experience, Think, and Share (LETS)[47] facilitated through an e-learning management system. In each weekly session, the participants viewed a themed educational video that presented evidence-based strategies for promoting mental health and emotional wellness. The participants were then encouraged to engage in the daily and weekly challenges by practically applying the lessons learnt from each topic (Table 1). The participants were awarded challenge points for successfully completing the tasks with a maximum of 100 challenge points per week. The e-learning management system incorporated gamification by ranking the participants’ challenge points on a leader board. The e-learning management system also included a social forum that allowed interaction between the participants. The participants were able to post pictures and comments relating to the challenges. The participants also received reading materials to expand upon the content presented in the videos, an e-workbook for journaling and reminder notifications to complete the weekly topics and challenges.

Outcomes and Measures

Participants of the intervention and control groups completed a self-reported wellness questionnaire, called the ‘7 Dimensions of Wellness Index’, three times during the study corresponding to baseline (Week 1), post-intervention (Week 12), and 12 weeks post-intervention (Week 24). The questionnaire measured: the mental health and vitality subscales of the 36-item Short Form Survey (SF36);[50] depression, anxiety and stress using the 21-item Depression, Anxiety and Stress Scale (DASS-21);[51] and life satisfaction using the five-item Satisfaction With Life Scale (SWLS).[52] The questionnaire also surveyed sociodemographic characteristics including age, gender, ethnicity, marriage status, level of education, and country of birth.

Sample Size Calculation

The sample size was calculated using assumptions based on published pilot data [48] and included the following assumptions: equal allocation of participants to each group; an improvement in depression, anxiety and stress scores of over 20% within the treatment group; a 40% attrition rate, based on reported levels of attrition in other online interventions;[39] 80% power and significance level of 0.05 (95% confidence interval). A small to moderate effect size was predicted based on comparative primary prevention interventions.[53]

Statistical Analysis

The data were analysed using SPSS Statistics (version 25). Descriptive statistics, involving frequencies, means, standard deviations and confidence intervals were used to present the data. Repeated measures General Linear Modelling (GLM) was used to test for group effects, time effects and group versus time interactions. Cohen's d was used to calculate effect sizes.

Results

Between July and August 2017, 510 participants self-selected to participate in the study (see Fig. 1). The trial commenced in September 2017 and was completed February 2018 (Week 24). Of the 508 eligible participants, 425 (68.8% females, aged 46.5 ± 15.6) completed the baseline assessment and entered the study (217 intervention, 208 control). As shown in Table 2, the intervention and control groups were similar in age, gender, ethnicity, and education. There were no significant differences between the intervention and control groups in the baseline measures of: mental health ($p = 0.564$), vitality ($p = 0.610$), depression ($p = 0.586$), anxiety ($p = 0.450$), stress ($p = 0.452$) and life satisfaction ($p = 0.972$), and these were within the normal range (Fig. 2). A total of 359 (85%) participants completed the post-intervention questionnaire (168 intervention, 191 control participants) and 321 (76%) completed the 12 weeks post-intervention questionnaire (159 intervention, 162 control).

Table 2
The Live More Project Intervention

Baseline characteristics	Intervention (n = 217)	Control (n = 208)
Age, mean (s.d.)	46.0 (16.2)	46.2 (15.1)
Gender, n (%)		
Men	68 (31.3)	64 (30.8)
Women	149 (68.7)	144 (69.2)
Ethnicity, n (%)		
White/Caucasian	184 (84.8)	166 (79.8)
Asian	9 (4.1)	10 (4.8)
Pacific Islander	4 (1.8)	17 (8.2)
Spanish/Hispanic/Latino	2 (0.9)	6 (2.9)
Indigenous	3 (1.4)	0 (0.0)
Black/African American	0 (0.0)	5 (2.4)
Other	9 (4.1)	4 (1.9%)
Education status, n (%)		
Primary/Elementary	2 (0.9)	1 (0.5)
Secondary/High School	23 (10.6)	36 (17.3)
Tertiary/University Undergraduate	92 (42.4)	80 (38.5)
Tertiary/University Postgraduate	100 (46.1)	91 (43.8)

Outcome measures

From Week 1 to 12, the intervention group experienced significant improvements in: mental health (10%, $p < 0.001$, $d = 0.50$) and vitality (22%, $p < 0.001$, $d = 0.54$) subscales of the SF-36; depression (-42%, $p < 0.001$, $d = 0.48$), anxiety (-38%, $p < 0.001$, $d = 0.39$) and stress (-31%, $p < 0.001$, $d = 0.52$) subscales of the DASS-21; and life satisfaction (8%, $p < 0.001$, $d = 0.48$) as measured by SWLS (see Fig. 2). At Week 24, the changes in these measures from Week 1 remained significant for: mental health (8%, $p < 0.001$, $d = 0.43$), vitality (19%, $p < 0.001$, $d = 0.48$), depression (-40%, $p < 0.001$, $d = 0.40$), anxiety (-29%, $p < 0.001$, $d = 0.33$), stress (-28%, $p < 0.001$, $d = 0.46$) and life satisfaction (8%, $p < 0.001$, $d = 0.47$).

The control group experienced significant improvements from Week 1 to Week 12 only in mental health (3%, $p = 0.028$, $d = 0.16$) and stress (-9%, $p = 0.038$, $d = 0.15$), but not in vitality (4%, $p = 0.089$, $d = 0.12$), depression (-10.%, $p = 0.112$, $d = 0.12$), anxiety (-6%, $p = 0.427$, $d = 0.06$) or life satisfaction (0%, $p = 0.872$,

$d = 0.01$). All measures for the control group were similar to those at Week 1 by Week 24 as indicated by the following changes: mental health (2%, $p < 0.169$, $d = 0.11$), vitality (5%, $p < 0.177$, $d = 0.11$), depression (-6%, $p < 0.551$, $d = 0.05$), anxiety (-5%, $p < 0.657$, $d = 0.03$), stress (1%, $p < 0.991$, $d = 0.01$) and life satisfaction (1%, $p < 0.715$, $d = 0.03$).

The changes in the intervention group from Week 1 to 12 were significantly greater ($p < 0.001$) than the control group for all measures: mental health ($d = 0.43$), vitality ($d = 0.48$), depression ($d = 0.40$), anxiety ($d = 0.33$), stress ($d = 0.46$) and life satisfaction ($d = 0.47$). The change in the intervention group from Week 1 remained significantly greater than the control group at Week 24: mental health ($p < 0.007$, $d = 0.30$), vitality ($p < 0.002$, $d = 0.34$), depression ($p < 0.005$, $d = 0.31$), anxiety ($p < 0.036$, $d = 0.24$), stress ($p < 0.001$, $d = 0.40$) and life satisfaction ($p < 0.003$, $d = 0.33$).

Harms

There were no reported harms that arose through the trial. No harms were anticipated given that the cohort where relatively healthy and the strategies implemented were positive lifestyle and psychological behaviours.

Discussion

To our knowledge, this is the first randomised controlled trial to examine the effectiveness of a multimodal online intervention combining an array of strategies from Lifestyle Medicine and Positive Psychology on mental health and emotional wellness amongst a healthy cohort. Hence, interventions such as those employed in this study may provide a response to the repeated calls for lifestyle interventions, psychological strategies, and education programs for the promotion of mental health and primary prevention strategies of common mental health disorders. [5, 8–11]

Targeting mental health promotion and prevention through interventions such as that used in the present study may provide a protective ‘buffer’ for individuals. For example, enhanced positive emotion may increase an individual’s ability to cope when faced with adversity,[14] and hence increase their resilience. The broaden-and-build theory asserts that the experiences of positive emotions may strengthen an individual’s personal, social and psychological resources, sparking upward spirals in their emotional wellbeing.[54] In turn, this may have a moderating impact on stress, anxiety and depressive symptoms. [55]

A unique aspect of the intervention used in this study was its multimodal design. To date, numerous studies have investigated the effectiveness of Positive Psychology techniques for improving mental health, including expressing gratitude, practising forgiveness, positive thinking and engaging in service activities;[38, 39] however, these strategies are often used in isolation. Similarly, while lifestyle factors such as diet[32] and exercise [28, 33, 56] are increasingly used as management and treatment modalities for mental illness, they are infrequently combined with psychological strategies.

It is notable that the effect sizes observed in this study are relatively greater than those reported in two meta-analyses of randomised controlled trials that did not account for the significantly smaller sample size and predominantly employed single-modality psychological strategies for the primary prevention of mental health.[42, 57–58] The larger effect sizes in this study might be attributable to a “compounding effect”, which reinforces the value of a multimodal approach. Encouragingly, within Positive Psychology greater attention is being given to combining psychological strategies, [59] however, other evidence-based lifestyle factors, such as physical activity and nutrition, are typically not integrated into these interventions.

Over the past decade, wellness interventions focusing on mental health have increasingly moved online, as compared to the conventional face-to-face mode of delivery.[60–62] Online interventions have been shown to be efficacious and may yield several advantages over face-to-face delivery, including cost-effectiveness, ease of delivery and scalability.[63]

Interestingly, the outcomes observed in this study are generally comparable to those observed in a cohort study that utilised the same intervention delivered face-to-face as part of a mandatory class for tertiary students.[48] However, there are several confounders in comparing the results of this cohort study to the present study, namely the participants in the present study were self-selected, of a broader age range and were generally healthier. There is a need to further explore the relative outcomes of mental health interventions when delivered online as compared to face-to-face.

Notably, the attrition rate in this study (24% at 12 weeks post-intervention) was relatively low compared to that typically reported in online interventions that do not involve the support of a health professional (often as high as 45%).[39, 64] A number of factors may have contributed to the low attrition rates observed in this study including the experiential pedagogical framework of the intervention and its interactive components, which are known to be key contributors to creating engagement in online interventions.[26]

Strengths and Limitations

A strength of this study was that it involved participants from a broad age range (18 to 88 years) and geographically diverse regions. Another strength of the study is that the intervention used an e-learning management system that was not reliant upon follow-up support from a healthcare professional. This suggests that such interventions might represent a scalable, low-cost method for the promotion of mental health and emotional wellness on a population-level.

A limitation of this study is that the participants where self-selected and hence may have entered the intervention with a higher readiness for change than that of the general population, thus limiting the generalisability of the findings. Secondly, as commonly seen when participants self-select into a Positive Psychology intervention, the gender balance was skewed towards females, which may limit the generalisability of the intervention to male cohorts. Notably, studies of Positive Psychology interventions have not shown the outcomes to be gender specific.[39, 41, 42] Thirdly, as the study targeted mental

health promotion, it does not inform the effectiveness of the intervention among a clinical population with a confirmed diagnosis. As discussed previously, this warrants further investigation given that a previous cohort study has indicated that individuals with lower levels of mental health reported the greatest benefits from the intervention.[47]

Public health implications

This study has important implications for public mental health research and practice. Firstly, an early intervention based on a multimodal approach, incorporating Lifestyle Medicine and Positive Psychology strategies, can be used to achieve significant improvements in mental health and emotional wellness. Secondly, it supports the concept of a “compounding effect”, whereby combining several evidence-based approaches for improving mental health and emotional wellness may result in greater benefits than a single-modality approach. Thirdly, online modes of delivery may present a low-cost and scalable opportunity for mental health promotion to improve mental health and emotional wellness.

Conclusion

Online multimodal interventions may be a cost-effective and scalable method of mental health promotion. There is a need for future studies to examine the impact of online multimodal interventions on at-risk and clinical populations to assess their potential role in secondary and tertiary prevention.

Abbreviations

SF-36
Short Form Survey (36 items)
DASS-21
Depression, Anxiety and Stress Scale (21-Items)
SWLS
Satisfaction With Life Scale
TPB
Theory of Planned Behaviour
LETS
Learn, Experience, Think and Share
GLM
General Linear Modelling

Declarations

Ethics approval and consent to participate

This study was approved by Avondale Human Research Ethics Committee [project number 2017:13]. The trial protocol is registered at The Australian New Zealand Clinical Trials Registry (ACTRN12619000993190). All participants provided online informed consent before screening took place.

Consent for publication

Not applicable.

Availability of data and materials

The datasets used and analysed during the current study are available from the corresponding author on reasonable request.

Competing Interests

The authors declare that they have no competing interests to declare. GP is a Health Strategist employed by the Seventh-day Adventist Church (SPD) Ltd that promotes a version of the intervention used in this study through the faith-based organisation's network and community.

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Author's contribution

GP, DM, LK & PB designed the study. GP & DM developed the intervention. GP drafted the manuscript, coordinated the trial and analysed the data. DM & LK provided supervision in the coordination of the trial and analysing the data. DM, LK & JM were major contributors in providing supervision in writing the manuscript. DM, JM, LK, JH, MR provided critical revision of the article. All authors read and approved the final manuscript.

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Figures

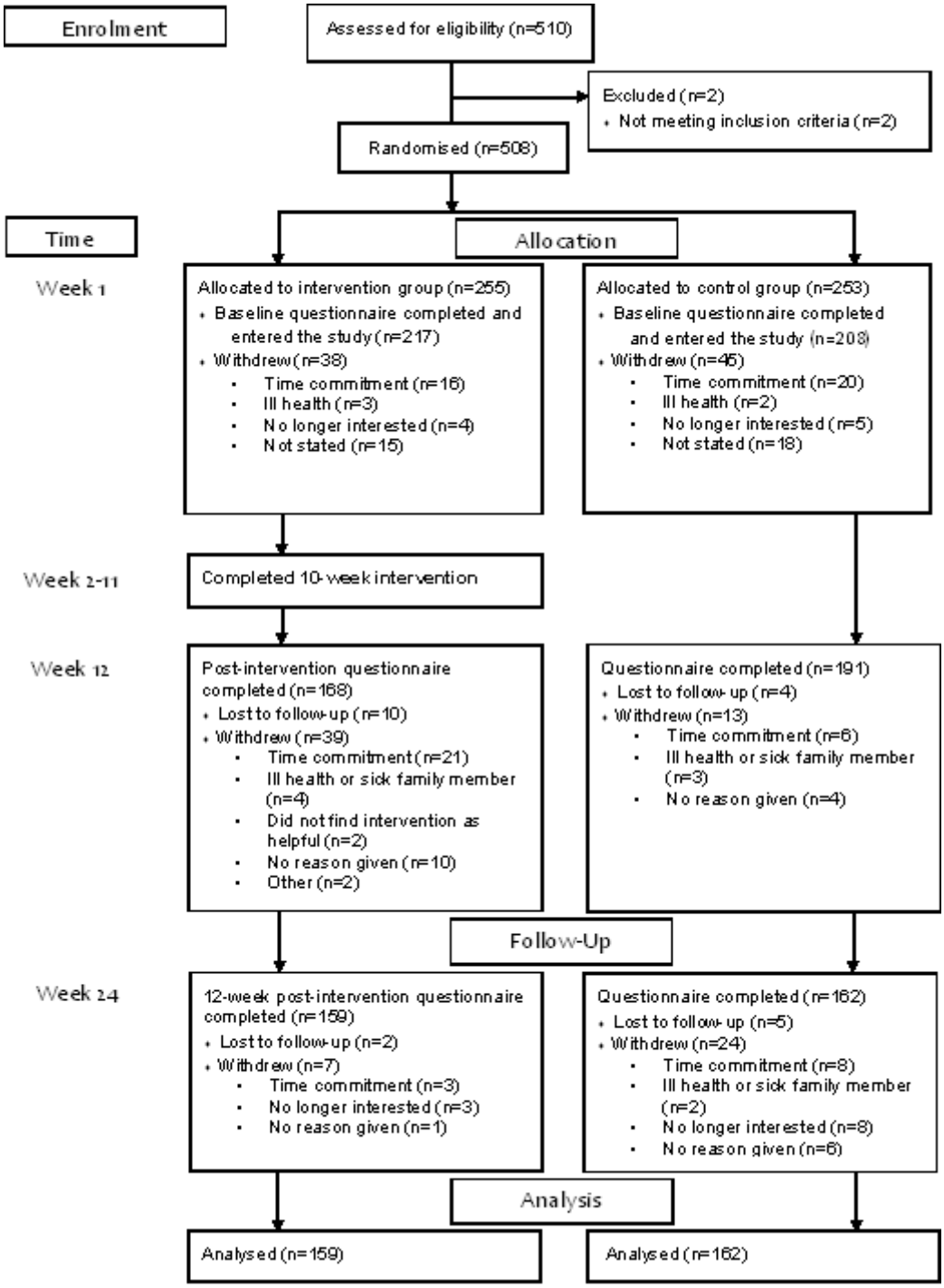

Figure 1

The Live More Project intervention CONSORT diagram

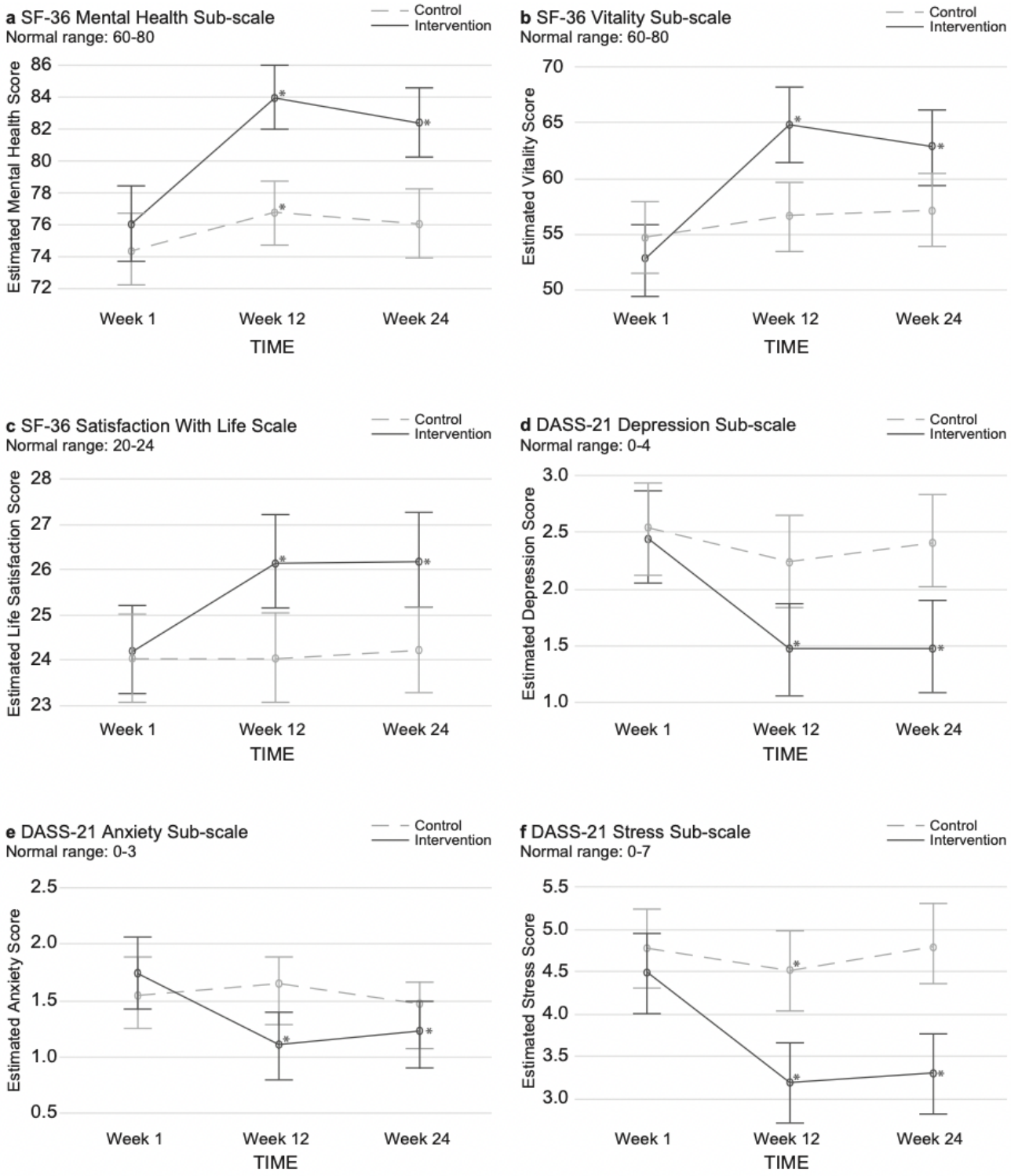

Figure 2

Mean scores on the outcomes measured using the SF-36 (positive affect) and DASS-21 (negative affect) scales across time (Week 1, Week 12 and Week 24), showing 95% confidence levels. * Indicates a significant difference compared to Week 1.