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Cost-effectiveness of online positive psychology: Randomized controlled trial

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As yet, no evidence is available about the cost-effectiveness of positive psychological interventions. When offered via the Internet, these interventions may be particularly cost-effective, because they are highly scalable and do not rely on scant resources such as therapists' time. Alongside a randomized controlled trial of an online positive psychological intervention, a health-economic evaluation was conducted. Mild to moderately depressed adults seeking self-help and recruited in the general population were randomly assigned to the intervention group ($n = 143$) and a waitlisted usual care group ($n = 141$). Improved clinical outcomes were achieved in the intervention group (at least for depression) at higher costs. When outliers (the top 2.5%, $n = 5$ in intervention group, $n = 2$ in control group) were removed, cost-effectiveness was increased considerably. For positive psychology, economic evaluations may be a means to nudge policy decision-makers towards placing positive psychological interventions on the health agenda.

Keywords: positive psychology; well-being; depression; cost-effectiveness; economic evaluation; randomized controlled trial

Introduction

Major depressive disorder is one of the leading contributors to the global burden of disease by causing disabilities and reduced quality of life (Vos et al., 2012). In addition to the human cost of depression, such as sad mood, isolation from significant others and an inability to enjoy life, high economic costs are involved. The annual per person costs are €5009, amounting to €311 million per one million people in the age bracket of 18–65 years (Smit et al., 2006). A study based on data from 28 European countries estimated that around 1% of gross domestic income is lost due to depression. Around one-third of these costs are direct medical costs, while absenteeism and premature mortality account for the other two-thirds (Sobocki, Jonsson, Angst, & Rehnberg, 2006). Promoting population health and preventing depression may not only be justifiable in its own right, but may also be associated with economic benefits.

For the prevention of depression, investing in well-being on a public level might be just as important as treating (subclinical) symptoms in individuals (Keyes, 2007). In a population-wide health promotion approach the wider 'not yet ill' population would be targeted with well-being interventions as a preventive inoculation against psychopathology (Huppert, 2009; Rose, 2008). This population-wide health promotion approach could be relevant for positive psychological self-help interventions, particularly when offered online (Bolier & Martin Abello, 2014). Online positive psychological interventions (OPPIs) have the potential to be highly accessible and scalable, reaching different kinds of populations. Moreover, they are, in theory, low-cost interventions, empowering people to manage their own well-being and thereby saving valuable time for professional therapists.

There is some preliminary evidence that OPPIs may impact on well-being and depression, however, these effects appear to be smaller than offline positive psychological interventions (Mitchell, Vella-Brodrick, & Klein, 2010). In addition to clinical evidence regarding the efficacy of OPPIs, information about their cost-effectiveness may also help policy-makers decide whether these interventions offer good value for money and should therefore be placed on the health agenda (Drummond, Sculper, Torrance, O'Brien, & Stoddart, 2005). However, OPPIs have not yet been evaluated from a health-economic perspective. One might expect these interventions to be cost-effective alternatives to their face-to-face counterparts since the online self-help format does not

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rely on scant resources. Moreover, well-being promotion, whether in online or offline format, is likely a cost-saving initiative in its own right, since the presence of well-being is related to enhanced work productivity and reduced healthcare costs (Keyes & Grzywacz, 2005).

Current study

A randomized controlled trial was conducted to examine the effectiveness of Psyfit (www.psyfit.nl), an online mental fitness self-help programme, which is based on positive psychology principles. The main findings of this trial have been published elsewhere (Bolier et al., 2013). Alongside the RCT, a cost-effectiveness study was conducted from a societal perspective. This is the most common perspective used in economic evaluations, which captures all costs, no matter who incurs the costs. We used this perspective because decisions regarding positive psychological interventions should be made in the interest of the general public, and not be confined to the (economic) gains of one institution or sector. We hypothesized that doing Psyfit would lead to improved well-being and reduced depressive symptoms, against cost savings.

Methods

Design

The study was designed as a randomized controlled trial in two parallel groups. Participants were randomized across two conditions: Psyfit and a waitlisted care-as-usual group. Online measurements were taken at baseline, two months and six months after starting the intervention. The study design, the intervention and the clinical findings are reported in detail elsewhere (Bolier et al., 2012, 2013). The study was approved by the Dutch Medical Ethics Committee for Mental Health Care, under registration number 9218 and was registered with the Netherlands Trial Register, part of the Dutch Cochrane Centre (NTR2126).

Participants and procedure

Participants were recruited from the general population via advertisements in free newspapers and banners on Facebook. The recruitment message was: 'Would you like to increase your mental fitness? Improve your mental fitness with an online program'. In this way a self-selected 'well-being seeking' sample was recruited. People could enrol at www.psyfit.nl. Next, they received an email with information on the study and were directed to the informed consent form and baseline questionnaire. To be included, applicants had to be over 21 years of age, have access to a computer and the Internet and be fluent in the Dutch language. Furthermore, they had to present mild to moderate depressive symptoms (score 10–24 on the CES-D) (Haringsma, Engels, Beekman, & Spinhoven, 2004) and a languishing or moderate level of well-being (as measured with the MHC-SF) (Lamers, Westerhof, Bohlmeijer, ten Klooster, & Keyes, 2011). Participants were excluded when presenting severe depressive symptoms (CES-D $\geq$ 25) and/or active suicidal thoughts or plans (question from the Web Screening Questionnaire) (Donker, van Straten, Marks, & Cuijpers, 2009). Those meeting the exclusion criteria were advised to seek professional help (general practitioner and/or the national suicide platform 113online.nl). Randomization took place after baseline measurement and was carried out using a computer generated randomization list in blocks of two, stratified by gender, education (high/lower) and depression symptom level (CES-D scores 10–15 and 16–24).

Intervention

Psyfit is an online self-help intervention, fully automated and without support from a therapist. The intervention aims to enhance well-being by fostering positive emotions and stimulate positive functioning. A parallel goal is to reduce depressive symptoms. The intervention is based on principles derived from positive psychology and focuses on positive experiences, strengths, and personal competencies rather than mental problems and deficiencies. It incorporates evidence-based exercises based on positive psychology, in addition to elements stemming from mindfulness, cognitive behavioural therapy and problem-solving therapy (Walburg, 2008).

There are six modules in Psyfit: (1) Personal mission statement and setting your goals, (2) Positive emotions, (3) Positive relations, (4) Mindfulness, (5) Optimistic thinking, and (6) Mastering your life. One module contains four lessons. Each week, one lesson consisted of psychoeducation and a practical exercise, thus a participant can finish a module in one month. At the end of the week, participants received an email notifying them that the next lesson could be started. Participants could start or finish modules as they wished, as long as they were in sequence. Other functionalities in Psyfit include several self-tests to monitor progress, videos showing Dutch experts, a personal action plan and an online community to share experiences among its participants.

Participants allocated to the intervention group received an email with a personal username and password. After logging in, two-month access to Psyfit was activated. Participants were advised to complete at least one module during the intervention period.

Waitlisted care-as-usual group

Participants in the control group were told they were on a waiting list for six months before they received their login codes for Psyfit. They were free to seek professional help (care-as-usual), if needed.

Clinical measures

The primary clinical outcome was well-being, as measured with a brief measure of positive well-being, the WHO Well-being index (WHO-5). The WHO-5 contains five positively formulated items on mental health. The WHO-5 has been validated in different populations (Henkel et al., 2003) and has shown high reliability (Cronbach's α of 0.84) (Bech, Olsen, Kjoller, & Rasmussen, 2003) WHO-5 scores vary between 0 and 25 with higher scores indicating better well-being. The secondary clinical outcome was depression, as measured with the Dutch version of the Centre for Epidemiological Studies Depression Scale, the CES-D (Radloff, 2009). The CES-D is a 20-item self-rating scale with item scores ranging from 0 to 3 (higher scores indicating more depression), and a total score from 0 to 60. The Dutch translation has demonstrated good reliability (Cronbach's α between 0.79 and 0.92) and validity (Bouma, Ranchor, Sanderman, & Van Sonderen, 1995).

Resource use measures

This study studied the cost-effectiveness of Psyfit from a societal perspective. This means that, according to standard economic evaluation procedures, all the costs related to the intervention were included: health service use, participants' out-of-pocket expenses and the costs due to productivity losses in paid work (Drummond et al., 2005). These data were collected using the Trimbos and Institute of Medical Technology Assessment Questionnaire for Costs for Psychiatry (TIC-P) (Hakkaart-van Roijen, van Straten, & Donker, 2002) for two periods: the month prior to randomization and the month prior to the six-month follow-up. There are indications that the TIC-P has satisfactory construct validity and is a reliable instrument to measure medical consumption and production losses in people with mild to moderate mental health problems (Bouwmans et al., 2013). Costs can be categorized as direct or indirect costs. Direct costs include medical and non-medical costs. Indirect costs encompass productivity losses.

Direct costs: costs of health services

Direct medical costs are those related to the healthcare system and include healthcare uptake costs, from both formal and informal health service providers, as well as medication. The costs of these health care services were calculated by multiplying the number of health care units by their standard cost price as reported in the Dutch guidelines for health-economic evaluations for the reference year 2009 (Hakkaart-van Roijen, Tan, & Bouwmans, 2010) (see Table 1 for an overview of the health service types and their costs). The costs of medication (antidepressants, sedatives and benzodiazepines) were calculated as the cost price per standard daily dose as reported in the Dutch Pharmacotherapeutic Compass (Broekhuijsen, Danz, Van Oppenraay, & Veurink, 2013), multiplied by the number of prescription days plus the pharmacist's dispensing costs of €14 per prescription.

Direct non-medical costs included travelling and parking expenses while visiting a health service provider. These costs were valued at €0.20 per kilometre and €3 per hour parking time. Furthermore, the loss of leisure time for participating in Psyfit was incorporated and valued at €12.50 per hour.

Intervention costs

In estimating the per-participant intervention costs, the average time spent on the intervention was valued at €12.50 per hour (leisure time value) for an average of 4 h per participant over the four-week intervention period (based on the adherence rate in Bolier et al., 2013). In addition, working time spent answering questions and the moderation of a forum were included for an average of three days a month over the course of the intervention (at €700/day). Further costs were related to website maintenance, which amounted to €6000 and €4500 per annum for upgrading and hosting the website, respectively. Recruitment costs were included as well, which amounted to €10,000.

Relying on data from a Dutch adult population survey (Westerhof & Keyes, 2008), 65% of the adult population's well-being is under pressure to a greater or lesser extent (languishing or moderate well-being, N= 8355,972). Taking a conservative approach, it was assumed that 10% would search for online help, of whom a final 1% would engage in the online self-help intervention. This resulted in estimated usage by 8356 participants per year. Based on the above assumptions and data, the per-participant intervention costs were estimated to be €55 as a lump sum.

Indirect costs: production losses

The costs stemming from production losses in paid work were calculated on the basis of the number of days absent from work (absenteeism), plus the number of days spent at work with reduced efficiency (presenteeism). Parameters were age, class, and gender (see costs in

Table 1. Direct medical and direct non-medical costs by health service type.

Health service type	Direct medical costs (in 2009 €)		Direct non-medical costs (in 2009 €)	
	Unit	Unit cost price[a]	km, h[b]	Unit cost price[c]
General practitioner	Contact	28	1.1, 1	15.72
Company doctor[d]	Contact	28	17.6, 0.5	9.77
Social worker	Contact	65	5, 2	29
Private practice psychotherapist, psychiatrist	Contact	90[e]	7, 2	29.4
Alcohol and drug consultant (CAD)	Contact	171	10[f], 3	42.5
Regional mental health service[g]	Contact	171	5, 3	41.5
Physiotherapist	Contact	36	2.2, 2	28.44
Mental Hospital	Contact	173	7, 3	41.9
Medical specialist General Hospital	Contact	64	7, 3	41.9
Medical specialist University Hospital	Contact	129	7, 4	54.4
Alternative treatment[h]	Contact	50.7	5, 1	16.5
Home care	Hour	35	NA	NA
Informal care (family, friends, self help)[i]	Hour	12.5	NA	NA

Note: NA, not applicable.
[a]Integral unit cost prices (cf. Hakkaart-van Roijen et al., 2010).
[b]Based on average distances (in special tariff taxi and public transport zones) and travel + waiting + treatment times (in h) for receiving treatment (cf. Hakkaart-van Roijen et al., 2010).
[c]Costs = (0.2 × km) + 3 + (12.5 × h). With €0.2 = cost per km; €3 = 1 h parking time; €12.5 = 1 h time (cf. Hakkaart-van Roijen et al., 2010).
[d]No parking costs assumed.
[e]Own calculation, valued as average of private practice psychologist, psychotherapist and psychiatrist (cf. Hakkaart-van Roijen et al., 2010).
[f]Assumed as CAD were more dispersed than regional mental health services.
[g]Psychologist and psychiatrist GGZ.
[h]Own calculation, valued as average of homoeopath and acupuncturist (cf. Hakkaart-van Roijen et al., 2010).
[i]Valued as domestic help (cf. Hakkaart-van Roijen et al., 2010).

Table 6.1 in Hakkaart-van Roijen et al., 2010, which were indexed to the year 2009).

Analysis

For the cost-effectiveness analysis, data from baseline to six-month follow-up were used.

Analysis of clinical outcomes

The analysis of the clinical outcomes was performed according to the intention-to-treat (ITT) principle, which follows the guidelines of the Consolidated Standards of Reporting Trials (Altman, 1996). Missing data at follow-up were imputed using the expectation maximization algorithm (EM) in the Statistical Package for the Social Sciences, version 19. EM is a single imputation method that replaces missing values in the data-set with estimates. The method contains two steps: In the expectation step, a value is estimated based on the available data and dispersion. In the maximization step, a fitting value is calculated based on the restructured data-set. This is an iterative process, until the most accurate estimation is reached. In a comparison of different imputation methods, EM imputation led to acceptable results, as opposed to last-observation-carried forward (Blankers, Koeter, & Schippers, 2010).

For both the well-being and depressive symptoms outcomes, clinically relevant changes were determined. For the WHO-5, Jacobson and Truax's algorithm for reliable and clinically relevant change was calculated (Jacobson & Truax, 1991), which turned out to be 5.91 points improvement on the raw scale. In addition, we decided that the participant had to score 13 points or higher (below 13 is an indication for depression (Bech, 2004)). For the CES-D, participants needed to score below the clinical cut-off score of 16 and improve at least five points, which is an accepted indication for clinically relevant change in CES-D depression (Beekman et al., 2002). Due to our included target group, participants who scored already below the cut-off score of 16 (10–15) needed to fulfil only the 5-points change criterion, whereas the participants presenting with moderate symptoms (16–24) had to fulfil both criteria. Participants were dichotomised according to these criteria into treatment responders and non-responders.

Cost-effectiveness analysis

The cost-effectiveness analysis was likewise conducted according to the ITT principle. The mean total and annualized costs for each of the conditions were calculated at baseline and follow-up (the monthly costs were multiplied by 12 months). The incremental costs were calculated as the between-group difference at post-test.

Incremental costs and incremental effects were used to calculate the incremental cost-effectiveness ratio (ICER) as $(C_1–C_0)/(E_1–E_0)$, where C is the average

annualized per-participant cost and E is the proportion of treatment responders in the experimental (1) and control condition (0). The ICER of each outcome describes the incremental costs for gaining one additional intervention response, and was calculated for both well-being and depression.

Stochastic uncertainty in the ICER was captured using a non-parametric bootstrap approach (with 2500 replications), producing a scatter of simulated ICERs. This cost-effectiveness plane represents a decision matrix, with differences in costs on the vertical axis and differences in health effects on the horizontal axis. If the dots appear mainly in the South-East quadrant of the plane, health gains are obtained for lower costs, resulting in an acceptable intervention from a cost-effectiveness perspective. Dots appearing in the North-West quadrant correspond to diminished health for increased costs, which means that the intervention is unacceptable in comparison to usual care. In the two other quadrants, higher or lower cost levels have to be weighed against greater or lesser effectiveness.

For decision-making purposes, a cost-effectiveness acceptability curve was produced when higher costs had to be weighed against greater effects. This curve represents the probability that the intervention is cost-effective relative to the control condition for one case for a range of willingness-to-pay (WTP) ceilings (€0–€100,000) for gaining one additional treatment responder.

Sensitivity analyses

Several sensitivity analyses were conducted. First, to determine the robustness of the results, the analyses were repeated for a scenario in which the intervention costs were assumed to be larger (€150 instead of €55), as this might be the case in another setting or country. Second, because it was found that the costs were driven by a few outliers, a separate analysis was conducted. In this separate analysis, the top 2.5% of the outliers with costs in excess of €45,000 were removed: $n = 2$ in the usual care group, and $n = 5$ in the Psyfit group. Third, a complete case analysis was conducted to check whether results were maintained examining those people who filled in all questionnaires. Fourth, the complete case analysis was also done under the outlier scenario.

Results

Flow of participants

After screening for eligibility, 284 of the 845 people that were interested in the study, were included (Figure 1 for flow of participants through the study). Attrition rate was 24.6% (70/284) at two-month follow-up and 30.3% (86/284) at six-month follow-up. Attrition rate was significantly higher in the Psyfit group, as compared to the control group. There were no significant differences between dropouts and completers regarding baseline symptoms. However, those who dropped out seemed to be of younger age ($\chi^2_1 = 4.2$, $p = 0.04$) compared to people who filled in all questionnaires.

Participants' characteristics

The mean age of participants was 43.2 years and most were female (226/284, 80%) and highly educated (208/284, 73%). The majority had paid employment (214/284, 75%). The mean score on the WHO-5 at baseline was 11.17 (SD 4.35) and on the CES-D 16.80 (SD 4.13), indicating a challenged level of well-being and a slightly elevated level of depressive symptoms. At baseline, mean per-participant annualized total costs were €5282 in the Psyfit group and €5966 in the control group (Table 2). There were no clinically or economically relevant differences at baseline between the study groups, indicating that randomization had resulted in comparable groups.

Effects

After six months, the number of participants showing clinically significant change for the WHO-5 was 25 (17.5%) in the Psyfit group as compared to 15 in the control group (10.6%) ($\chi^2_1 = 2.75$, $p = 0.10$). The difference in effectiveness was $0.175 - 0.106 = 0.07$. For the CES-D, clinically significant change was observed in 64 participants in the Psyfit group (44.8%) vs. 42 participants in the control group (29.8%) ($\chi^2_1 = 6.80$, $p = 0.01$). The difference in effectiveness was $0.448 - 0.298 = 0.15$.

These results were comparable with the results that were found on the continuous measures (Table 3): From baseline to six-month follow-up well-being as measured with the WHO-5 was not-significantly higher in the Psyfit group ($\beta = 0.09$, $p = 0.11$, Cohen's $d = 0.26$), and depressive symptoms were significantly reduced ($\beta = -0.13$, $p = 0.02$, Cohen's $d = 0.35$).

Cost-effectiveness

Table 2 presents the direct, indirect and total annualized costs based on imputed data. Table 4 contains the cost-effectiveness analysis (total sample). At six-month follow up, the average total annualized per-participant costs were €6888 in the experimental group and €5417 in the control group, hence. Hence, the incremental costs were €6888 − €5417 = €1471. The majority of the costs stem from production losses at paid work.

For WHO-5 well-being (see Figure 2), the ICER is 1471/0.07 = 21,319, which implies additional costs of €21,319 for gaining one treatment response. On the

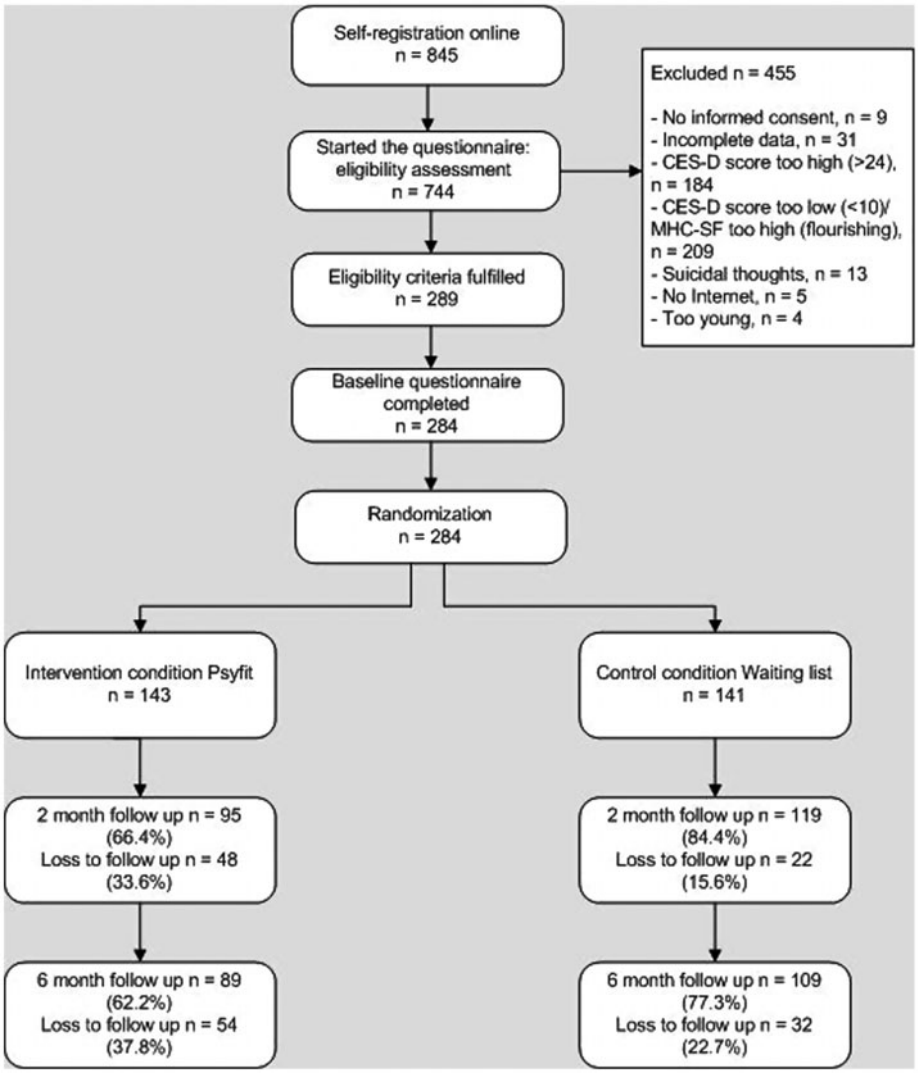

Figure 1. Flow of participants through the study.

cost-effectiveness plane, the majority of the simulated ICERs (73%) occur in the North-East quadrant. This indicates that with a probability of 73%, a health gain is produced by applying the intervention, but at additional costs. The other ratios show up in the South-East quadrant (18%, indicating health gains at lower costs), in the North-West quadrant (7% indicating negative effects at higher costs) and in the South-West quadrant (2% indicating negative effects, with cost savings). The incremental cost-effectiveness acceptability curve shows that when there is no willingness to pay, there is a 23% probability that the intervention is more cost-effective than care-as-usual. When the willingness to pay for a favourable treatment response is €10,000, €20,000 or €30,000 this probability rises to 34, 47, and 61%, respectively.

For CES-D depression (see Figure 3), the ICER is €1471/0.15 = €9807 per treatment responder. Again, most ICERs (79%) are located in the North-East quadrant, showing that there is a large probability that health gains are obtained for additional costs. There is a 19% probability that the intervention is effective with cost savings (the South-East quadrant) and a 2% probability that the intervention is ineffective at higher costs (North-West quadrant). In terms of acceptability, there is a 22% probability that the intervention is more effective than care-as-usual when there is no WTP. When the willingness to pay for a favourable treatment response is €10,000, €20,000, or €30,000, this probability increases to 47, 71, and 83%, respectively.

Sensitivity analysis

Sensitivity analysis A underscores the overall conclusion that the intervention produced better health outcomes, at

Table 2. Annual per capita costs by condition and time.

	€, 2009[a]			
	Baseline	(SD)	6 m follow-up	(SD)
Care as usual condition ($N = 141$)				
Direct medical costs[b]	1187	(2187)	1037	(1646)
Direct non-medical costs	497	(821)	387	(556)
Absenteeism[c]	2625	9118	2257	8118
Presenteeism	1657	2997	1736	3123
Intervention costs	NA		NA	
Total costs	5966	(10,202)	5417	(9070)
Online self-help condition ($N = 143$)				
Direct medical costs	1316	(1855)	1307	(1788)
Direct non-medical costs	484	(699)	457	(639)
Absenteeism	1608	5856	3067	10,195
Presenteeism	1874	3599	2001	4046
Intervention costs	NA		55	(0.0)
Total costs	5282	(8021)	6888	(12,746)

Notes: Total costs are the sum of the other cost components. Differences in the totals are due to rounding. NA, not applicable.
[a]Mean costs based on a monthly basis (cf. Hakkaart-van Roijen et al., 2010).
[b]Including medication.
[c]Presenteeism, absenteeism all relate to production losses (indirect costs).

Table 3. Effects of Psyfit on the continuous measures.

Measures		Mean	SD	*d*	Mean	SD	*d*	*β*	*p* value	Δ*d*
WHO-5	Baseline	10.81	4.31		11.52	4.38				
	six-month	12.92	4.77	0.47	12.45	4.61	0.21	0.09	0.11	0.26
CES-D	Baseline	16.91	4.16		16.67	4.12				
	six-month	13.06	7.55	0.63	14.94	7.48	0.28	−0.13	0.02	0.35

Table 4. Cost-effectiveness analysis and sensitivity analysis.

	Total sample		Alternative scenarios							
			A		B		C		D	
	WHO-5	CES-D	WHO-5	CES-D	WHO-5	CES-D	WHO-5	CES-D	WHO-5	CES-D
Costs[a]	1471	1471	1565	1565	463	463	2276	2276	−205	−205
Effect	0.07	0.15	0.07	0.15	0.07	0.15	0.04	0.16	0.05	0.18
ICER, €	21,319	9807	22,681	10,433	6431	3087	53,993	13,871	−4068	−1166
Distribution in the CE-plane										
1st quadrant (n-e)	73	79	73	79	51	54	66	84	31	39
2nd quadrant (inferior: n-w)	7	2	8	2	6	2	19	1	9	1
3rd quadrant (s-w)	2	0	2	0	5	1	3	0	12	1
4th quadrant (dominant, s-e)	18	19	18	18	39	44	12	15	48	60
WTP ceiling, %										
€0	23	22	22	22	44	47	18	18	60	62
€10,000	34	47	33	47	68	82	22	39	69	90
€20,000	47	71	47	70	80	90	32	63	74	96
€30,000	61	83	60	84	84	95	40	78	77	98

Notes: ICER = Incremental Cost-Effectiveness Ratio, scenario A = intervention costs raised to €150, scenario B = outliers 2.5% from the top excluded (two excluded in usual care group and five excluded in Psyfit group), scenario C = completers sample ($N = 109$ usual care group, $N = 89$ Psyfit), scenario D = completers sample, outliers excluded ($N = 107$ usual care group, $N = 84$ Psyfit).
[a]Costs per 'disease-free' year at 2009 prices.

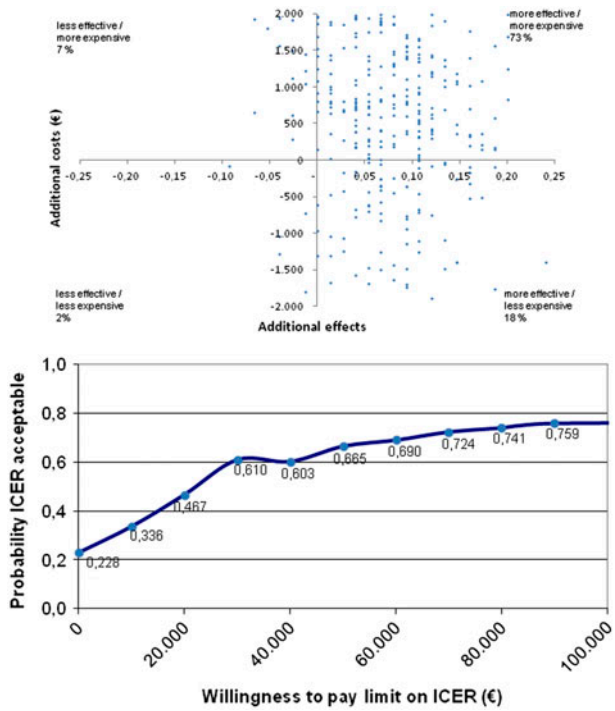

Figure 2. WHO-5 cost-effectiveness plane and acceptability curve.

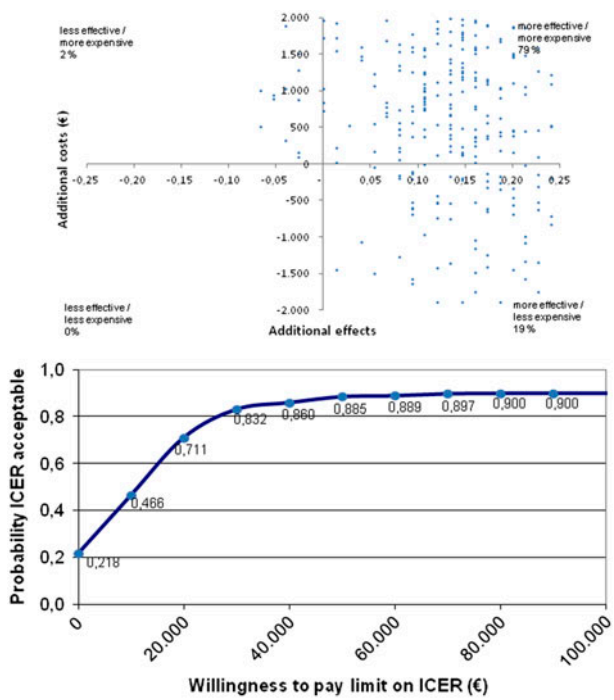

Figure 3. CES-D cost-effectiveness plane and acceptability curve.

higher costs. In scenario A, after hypothetically raising the intervention costs to €150, the ICERs slightly increase to €22,681 and €10,433, respectively. Distribution in the CE-planes and the probabilities at different WTP ceilings remain about the same.

When participants with outlying annual costs in the top 2.5% are excluded (scenario B, two participants in the usual care group and five participants in the Psyfit group), cost-effectiveness is more favourable in both the CE-plane and the acceptability curve, and the intervention has a 44–47% probability of being more cost-effective when there is no willingness to pay. The probabilities of the acceptability curves rise when higher WTP ceilings are deemed acceptable. For example, at a WTP of €10,000, the probability that Psyfit is more cost-effective rises to 68% for the WHO-5 and to 82% for the CES-D.

In scenario C, the complete case scenario, a similar picture emerged as in ITT sample for the CES-D: better health outcomes were reached against higher costs. For the WHO-5, the ICER was substantially raised, as compared to the ICER in the ITT sample (from 21,319 to 53,993) stemming from a lowered effect size (from 0.07 to 0.04). Removing the outliers gave a dramatically different representation of the data (scenario D): better health outcomes were reached against considerable cost savings (the 4th quadrant is now dominant in both distribution planes). At a WTP level of €0, there is a 60–62% probability that Psyfit is cost-effective.

Discussion

Main findings

The aim of this randomized controlled trial was to examine whether an OPPI to enhance mental fitness and reduce depressive symptomatology would be cost-effective. The proportion of participants that showed clinically relevant change on the main outcome well-being was (not significantly) higher in the intervention group: 17.5% in the intervention group as compared to 10.6% in the care-as-usual group. For depression, clinical change occurred in 44.8% of the participants in the intervention group and in 29.8% of the participants in the control group. Although Psyfit was demonstrated to be more effective than the usual care group, at least for depression, this economic evaluation indicates that the intervention is not cost-effective from a societal point of view. The better effects are obtained for substantially higher costs (€21,319 and €9807 per treatment responder on well-being and depression, respectively). Under the hypothetical scenario that there is no willingness to pay for treatment response, there is a 22% probability that the intervention is more cost-effective than usual care. In general, there is at least some willingness to pay for a health gain, but it remains to be seen if the WTP would be as high as close to €10,000 for a clinically significant reduction in depressive symptomatology plus a less

pronounced increase in well-being. The majority of the costs stem from production losses. Sensitivity analyses with a hypothetical increase in intervention costs and in the complete case sample attested to the robustness of these findings. However, when the top 2.5% high-cost outliers were removed (7 outliers), the cost-effectiveness of Psyfit looked more favourable for both well-being and depression, especially in the complete case sample.

From a health-economic point of view, Psyfit has not produced large benefits in the overall sample. This result is not consistent with the growing body of evidence that Internet-based interventions can be cost-effective, as demonstrated, for example, in the case of cognitive behavioural therapy via the Internet to treat depression, social phobia or panic disorder (Hedman, Ljotsson, & Lindefors, 2012). What might have caused the limited cost-effectiveness? The major cost-driver for the intervention group was obviously not the intervention costs of €55, but it appeared that participants in the intervention group generated more productivity losses as compared with the participants in the usual care group. In particular, the costs for absenteeism were higher in the intervention group. This was a puzzling finding since there was no indication of loss of health and vitality in the intervention group (Bolier et al., 2013). A possible explanation could be that through gaining increased awareness of their stress, people in the intervention group took sick leave more frequently by way of prevention and in the context of better self-management. Whether this is really the case is unknown, since we did not ask why they reported themselves sick. We could also speculate that having followed the intervention, people might adhere more tenaciously to their personal life goals and values, discovering in the process that their job wasn't the most important thing in life. This may have increased their willingness to report sick more often or for longer periods of time.

A closer look at the data revealed that there was no difference between the *number* of people that became sick listed in the intervention group compared to the control group. However, there was a small minority of participants in the intervention group that lost many working days, thus increasing total absenteeism. When we removed some of these outliers (top 2.5%) in both the intervention group ($n = 5$) and the usual care group ($n = 2$), cost-effectiveness increased substantially. Minus the outliers, and at a WTP of €0, the intervention has a probability of 44–47% of being cost-effective; with a WTP of €10,000 this probability rises to 68–82%. Whether Psyfit is cost-effective or not, is ultimately up to the judgement of the decision-makers. Much depends on the willingness to pay and, it appears, on the impact of outliers.

Limitations

Several limitations of this study need to be recognized. First, the outcomes of this cost-effectiveness analysis seem to be affected by a limited number of outliers. This will likely cause insecurity in the decision-making process. Second, there was a rather high attrition rate in this trial and in addition selective dropout. Although not an uncommon phenomenon in online interventions (Eysenbach, 2005), the procedure for handling the missing data may not have been entirely successful in eliminating this bias. Third, the costs and effects were examined in a relatively short time-span of six months. Consequently, we do not know how the cost-effectiveness would have been over the longer term. Fourth, we used a waitlisted usual care group and therefore we could not blind participants to the condition to which they were assigned. Even though this is the case for most randomized trials of psychological interventions, it may have distorted the outcomes. Fifth, we did not consider changes in the costs in the domestic realm, while it is common in economic evaluations to value these as well (Drummond et al., 2005). Sixth, participants in the trial were a self-selected sample of mainly highly educated women. To generalize results to the wider population of mildly depressed people, more men and lower educated people have to be reached, perhaps by adapting the recruitment method and/or intervention. Because of these limitations, the results of this study should be considered with caution.

Recommendations and future directions

What could positive psychology learn from economic evaluations in general and from this CEA study in particular? In general, CEA can evaluate the economic costs and benefits associated with the clinical outcomes of positive psychological interventions. Clearly, decision-makers would be more likely to consider interventions that not only improve health outcomes, but are also affordable economically, thus offering good value for money. If the cost-effectiveness of positive psychological interventions would be established, this could encourage investment in the implementation of these interventions from stakeholders such as companies, schools and municipalities. Positive psychology can learn from CEAs and other economic evaluations in the medical field, by using the same standards for designing, conducting and reporting health-economic evaluations (Drummond et al., 2005; Husereau et al., 2013). In addition, it may make sense for positive psychology to look beyond the medical model, because the interventions tend to have broad impacts – often extending beyond well-being and symptom reduction. In the current study, we looked mainly at

illness-based cost drivers and thus we may not have captured all benefits. Assessing the cost-effectiveness of public health interventions, which Psyfit is considered to be, requires a broad perspective on intersectoral costs and consequences (Weatherly et al., 2009). As we know, enhanced well-being is related to many positive outcomes for the individual and for society (Lyubomirsky, King, & Diener, 2005). It would be interesting to establish what the cost-savings would be, for example, of greater creativity, innovation or enhanced prosocial behaviour. In addition to CEAs, other types of economic evaluations can be applied, such as a cost-benefit analysis in which monetary value is linked to the outcomes, or a cost-consequence analysis, which allows decision-makers to select components and health benefits that are most relevant to their perspective and needs.

The current study sets a first example of how a CEA in positive psychology can be designed and conducted. The results raise questions on how to improve the cost-effectiveness of the intervention. As we have seen, removing outliers sheds another light on the results. Also, there could be other conditions under which the intervention might be more effective and cost-effective as well. In the six-month follow-up, which data was used for the cost-effectiveness analysis, depressive symptoms were still significantly reduced, but the raised well-being level was no longer maintained. The adherence rate in Psyfit was rather low; although a large part (112/143, 78%) followed at least one lesson in a module, less than 10% (13/143) finished the intervention according to the protocol (Bolier et al., 2013). If adherence could be enhanced, the effectiveness might well improve, as other research has shown (Donkin et al., 2011). In positive psychology interventions, it is imperative to establish a good 'person-activity fit', thereby connecting the intervention to the needs and preferences of the user (Lyubomirsky, Dickerhoof, Boehm, & Sheldon, 2011). To maintain an elevated level of well-being, an ongoing effort in doing the exercises might be needed, as people may have a tendency to return to their personal 'set-point' level of well-being (Sheldon & Lyubomirsky, 2006). Although Psyfit already contains some engaging and motivating elements, such as self-monitoring and a free choice of modules, the effectiveness and subsequent cost-effectiveness of Psyfit and other OPPIs in general could be improved by incorporating more persuasive elements, such as personalized feedback and tailoring of the intervention needs and preferences (Kelders, Kok, Ossebaard, & Van Gemert-Pijnen, 2012). Another way to boost the (cost-)effectiveness of Psyfit and other OPPIs would be to identify who benefits most from the intervention and whether there are certain subgroups for whom Psyfit is counterproductive. In that way, interventions can be targeted and/or tailored to these particular groups. Lastly, it might be wise to pay attention in the intervention to well-being and mental health complaints in relation to work-related issues, in order to deal with the diminished productivity in the intervention group.

Conclusion

To the best of our knowledge, this is the first study to examine the health-economic consequences of a positive psychological intervention. In the cost-effectiveness analysis, improved clinical outcomes were achieved (at least for depression), though at higher costs. In conclusion, we recommend looking for ways to increase the cost-effectiveness of Psyfit, for example, by increasing adherence and longer term effectiveness, or by targeting the intervention to particular subgroups for whom the intervention works best. Replications of this study are needed. For positive psychology in general, we recommend considering the possibilities of economic evaluations alongside randomized trials, as they may help (online) positive psychological interventions to gain a firm foothold on the public health agenda for the twenty-first century.

Conflicts of interest

Trimbos Institute is the developer of Psyfit and has a share in the social venture that implements the intervention. Neither the authors working at the Trimbos Institute nor the institute itself derive financial income from the interventions.

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