DISSERTATION

E-MENTAL HEALTH – USING DIGITAL TECHNOLOGIES TO ADVANCE MENTAL HEALTH CARE

Elena Phillips

E-mental health – using digital technologies to advance mental health care
Cumulative thesis

Submitted at the Faculty of Business Administration (Hamburg Business School) of Universität Hamburg
Moorweidenstr. 18
20148 Hamburg / Germany

to obtain the academic degree of a „doctor rerum oeconomicarum“ (Dr. rer. oec.) *(PromO 2014)*

by Elena Phillips

Hamburg, January 20th, 2021

Chairperson:	Prof. Dr. Petra Steinorth
First Examiner:	Prof. Dr. Jonas Schreyögg
Second Examiner:	Prof. Dr. Hans-Helmut König
Submission date:	20 January 2021
Disputation date:	4 May 2021

Contents

Thank you words

I am happy that I could experience an adventure of a researcher and dedicate myself scientifically to a fascinating and significant topic such as mental health**.** I want to express my biggest gratitude and appreciation to several people.

To my first supervisor, Prof. Dr. Jonas Schreyögg, who was a big inspiration for me professionally, as well as personally, especially for your open-mindedness, creativity, support, and motivation.

To my second supervisor, Prof. Dr. Hans-Helmut König, for trusting in my abilities and giving me freedom to learn by doing.

To my co-author, Sebastian Himmler, for your curiosity and strengths that perfectly completed my skills, as well as the outstanding remote collaboration that resulted in two studies included in this dissertation thesis.

To my co-author, Dr. Vladimir Gordeev, whose expertise, support, experience and humor made this scientific journey an exiting one.

To my friend, Stefanie Brunner, for our never-ending conversations about everything that enriched every aspect of my life including this dissertation thesis, your amazing sense of humor and your loving heart.

To my mother Irina, who was standing by my side and supporting me with incredible energy and loving dedication, as well as looking after my son, who was born in the beginning of this research journey.

To my son Leo, for your existence and love that you brought into my life. You are my biggest inspiration and motivation for everything I do in my life since you were born.

List of tables

List of figures

1 Introduction

1.1 Background

Good mental health, which is defined by the World Health Organization (WHO) as "as a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to her or his community" (1), is essential in all areas of our lives. It is crucial for the fruitful and successful existence of our society (2). European policymakers have acknowledged good mental health and mental well-being as a fundamental contributor to the quality of life and sustainable development of Europe through the WHO Ministerial Conference and the EC Green Paper on Mental Health in 2005 (3). In 2015, for the first time, world leaders acknowledged the crucial importance of mental health by the inclusion of the promotion of mental health and wellbeing in the Sustainable Development Agenda. Adopted at the United Nations General Assembly in September 2015, Goal 3 of the 17 Sustainable Development Goals (SDGs) focuses on ensuring mental health and prevention of mental ilnesses: "prevention and treatment of non-communicable diseases, including behavioural, developmental and neurological disorders, which constitute a major challenge for sustainable development" (4).
While the importance of mental health has gained political attention in recent years, with one in every two people experiencing a mental illness in their lifetime, mental health disorders belong to the largest and fastest-growing groups of the burden of disease worldwide (5). The increase of mental health problems globally affects our wellbeing and creates challenges for health systems in their allocation of scarce health care resources. In industrialised countries, people seeking psychological treatments often have to face long waiting times (6). Apart from the ethical value of wellbeing and the problem of resource allocation, mental health illnesses are also a serious cost-driver for economies globally. They can cause an economic burden up to 4% of GDP and also indirectly burden economies due to productivity losses (5).

Employees' poor mental health can negatively influence productivity and work performance, resulting in increased absenteeism, presenteeism, and higher staff turnover (7, 8). In Germany in 2017, 16% of the sick days were due to mental illnesses, and for decades mental illnesses have been the most common reason for early retirements with 41,7% in 2019 (8, 9). The rising awareness of the potentials and risks for the mental health of the workplace where people spend the majority of their life has led to the greater attention to occupational mental health and the increase of mental health promotion in the workplace (10).

How to keep and promote good mental health, prevent mental illnesses and to find innovative strategies and methodologies for their treatment (11, 12) is one of the key questions for future mental health research and practice. In this context, digital treatment formats, also called e-mental health interventions (eMHIs[1]), have gained attention as emerging technologies that have a potential to contribute to the solution of the access and resource allocation problem in mental health care. eMHIs are usually self-help mental health prevention or psychological treatment programs for people with mild to moderate symptoms across psychological conditions. -These programs are delivered via information and communications technology (ICT), mostly accessible via personal computers, tablets or smartphones (13). eMHIs are presence oriented and based on established psychotherapy approaches such as cognitive-behavioral theory (CBT) and its further developments like acceptance and commitment therapy (ACT) or mindfulness-based cognitive therapy (MBCT) (14-16). eMHIs have been found to be effective in improving mental health in the general public in previous research with effect sizes comparable to those seen for face-to-face psychotherapeutic interventions (14, 17, 18). The eMHIs can be used as standalone treatment solutions or in the blended care (BC) format, which combines the use of eMHIs and traditional face-to-face therapy, uniting technological advantages with the preferred personal contact with a therapist (19).

[1] In the following, the terms "e-mental health interventions", "online interventions", and "online psychological treatment" are used interchangeably.

1.2 Research goals and contents

Due to their flexible modes of delivery and low barriers to access, eMHIs are encouraging, not only in treatment but especially in the prevention of mental disorders and the promotion of mental health, also in non-clinical settings. There is an increased demand for action on mental health promotion in the workplace, which is supported by evidence that the workplace and its environment have a significant influence on mental health and wellbeing (20). Workplace mental health promotion is enjoying increasing popularity, and previous research has shown positive results in terms of the increase of workers wellbeing as well as of an economic return on investment in several workplace health promotion programmes (21). While the question of the effectiveness of eMHIs in the clinical setting or general population has been addressed in previous research with promising results, the evidence regarding occupational e-mental health is limited (22, 23). Thus, the first aim of this dissertation was to investigate the effectiveness of eMHIs in an occupational context, exploring potentials and limits of these technologies in mental health promotion and treatment of mild psychological conditions in non-clinical settings.

The clinical application of eMHIs is expected to tackle health care challenges regarding access and resources allocation. Recently, in light of the COVID-19 pandemic and its prevention measures, the call for the use of digital technology in mental health care has increased (24). The outbreak of the pandemic was even called a “turning point” for e-mental health and pushed the utilisation and development of video conferencing technologies for therapeutic purposes and eMHIs worldwide (24, 25). However, despite the proven effectiveness and delivery advantages, the acceptance of eMHIs among the general population and therapists, although varying across different countries, is still limited (26-30). The reasons for the unfavourable perception of eMHIs are not yet well understood. Thus, the second aim of this dissertation was to investigate the underlying reasons for the low acceptance of eMHIs by exploring attitudes and preferences towards eMHIs among users and providers in Germany,

which serves as an example of a country with low e-mental health utilisation level. Knowing patients and therapist's favourite application scenarios of eMHIs~~,~~ can help policymakers and eMHIs developers create conditions and design application formats, that are more attractive to patients and therapists, which could increase the acceptance and uptake of such services.

Chapter 1 with the study "Effectiveness of occupational e-mental health interventions: a systematic review and meta-analysis of randomised controlled trials" focuses on the application of e-mental health in the occupational setting, the so-called occupational eMHIs. The presented study aimed to investigate the effectiveness of occupational eMHIs and their variation in effectiveness depending on different mental health areas using a systematic review and meta-analysis as a methodology. To answer this question as comprehensively as possible, we broadened the focus of the review to every mental health area of occupational e-mental health through an extra broad search strategy, performing a meta-analysis for each outcome and considering a broader set of moderators obtained from previous research.

Chapter 2 "Preferences for e-mental health interventions in Germany: a discrete choice experiment" explores perceptions and preferences towards eMHIs among the German general population. Despite the proven effectiveness and certain advantages in terms of accessibility and flexibility, the acceptance of eMHIs among the general population is still limited (26-29). The underlying reasons for this perception of eMHIs have been addressed in previous studies with conventional survey techniques with inconclusive results (27, 29, 31). To address this research gap from the new methodological perspective, we employed the unified theory of acceptance and the use of technology (UTAUT), formulated by Venkatesh (32), to structure the findings of previous research and conducted the discrete choice experiment (DCE). The DCE format investigates preference offering a choice between hypothetical eMHIs treatment options, thus making eMHIs more tangible to participants in comparison to conventional survey techniques. Chapter 2 provides valuable insights on preferences of use for eMHIs differentiating between participants with and those without previous experience of psychotherapy or

counselling, and two application context scenarios (prevention vs clinical condition (depression).

Chapter 3 with the study "Preferences of psychotherapists for blended mental health interventions in Germany: a discrete choice experiment" shifts focus from the patient´s perspective towards the perspective of providers exploring perceptions and preferences of psychotherapists on eMHIs. Therapists´s attitudes towards eMHIs differ to a large extent depending on therapeutic orientation or geographical location. Therapists in countries with a higher level of dissemination of e-mental health, such as the Netherlands, Sweden and United Kingdom, show optimistic attitudes towards eMHIs, by contrast, therapists in countries such as Austria and Germany, with lower e-mental health utilization are more sceptical regarding eMHIs (30, 33, 34). In general, it is still unclear which underlying reasons lead to the hesitation towards eMHIs among psychotherapists, and under which conditions they would be ready to make use of eMHIs. The first studies on attitudes towards eMHIs among psychotherapists have shown a preference towards blended care treatment, which is associated with lower risks and disadvantages compared to the standalone use of the eMHIs (33, 35-37). Thus, the study presented in Chapter 3 aimed to explore previous experiences with and preferences for the use of BC, as well as attitudes towards specific features of BC among psychotherapists in Germany serving as an example of a country with low-level e-mental health utilization.

Finally, chapter 4 summarizes the main findings and contributions of presented studies and draws implications for the mental health practice and future research on e-mental health.

1.3 References

1. WHO. WHO urges more investments, services for mental health. https://www.who.int/mental_health/who_urges_investment/en/, 20 December 2020.

2. Fledderus M, Bohlmeijer ET, Smit F, et al. Mental health promotion as a new goal in public mental health care: a randomized controlled trial of an intervention enhancing psychological flexibility. *Am J Public Health*. 2010; 100: 2372.

3. Stansfield J. Improving the mental health of the population: a strategy for Europe. J *Public Ment Health.* 2006; 5: 11-13.

4. WHO. Mental health included in the UN Sustainable Development Goals. https://www.who.int/mental_health/SDGs/en/, 20 December 2020.

5. OECD. Mental Health. https://www.oecd.org/els/health-systems/mental-health.htm, 20 December 2020

6. Samartzis L, Talias MA. Assessing and Improving the Quality in Mental Health Services. *Int J Environ Res Public Health.* 2019; 17.

7. Goetzel RZ, Long SR, Ozminkowski RJ, et al. Health, absence, disability, and presenteeism cost estimates of certain physical and mental health conditions affecting U.S. employers. *J Occup Environ Med*. 2004; 46: 398-412.

8. BAuA. Volkswirtschaftliche Kosten durch Arbeitsunfähigkeit 2017. https://www.baua.de/DE/Themen/Arbeitswelt-und-Arbeitsschutz-im Wandel/Arbeitsweltberichterstattung/Kosten-der-AU/Kosten-der-Arbeitsunfaehigkeit_node.html, 20 December 2020.

9. Deutsche Rentenversicherung. Erwerbsminderungsrenten im Zeitablauf 2020. https://www.deutsche-rentenversicherung.de/SharedDocs/Downloads/DE/Statistiken-und-Berichte/statistikpublikationen/erwerbsminderungsrenten_zeitablauf_2020.html, 20 December 2020.

10. WHO. Mental health in the workplace. https://www.euro.who.int/en/health-topics/noncommunicable-diseases/mental-health/areas-of-work/mental-health-in-the-workplace, 20 December 2020.

11. World Health Organization and Calouste Gulbenkian Foundation. *Social determinants of mental health*. Geneva, World Health Organization, 2014.

12. Jane-Llopis E. Mental health promotion: concepts and strategies for reaching the population. *Health Promot J Austr*. 2007; 18: 191-7.

13. Ebert DD, Erbe D. Internetbasierte psychologische Interventionen. In: Rief W, Berking M, eds. *Klinische Psychologie und Psychotherapie.* Springer; 2012: 131-140.

14. Christensen H, Hickie IB. Using e-health applications to deliver new mental health services. *Medical Journal of Australia*. 2010; 192.

15. Ly KH, Asplund K, Andersson G. Stress management for middle managers via an acceptance and commitment-based smartphone application: A randomized controlled trial. *Internet Interv*. 2014; 1: 95-101.

16. Jayewardene WP, Lohrmann DK, Erbe RG, et al. Effects of preventive online mindfulness interventions on stress and mindfulness: A meta-analysis of randomized controlled trials. *Prev Med Rep*. 2017; 5: 150-59.

17. Barak A, Hen L, Boniel-Nissim M, et al. A Comprehensive Review and a Meta-Analysis of the Effectiveness of Internet-Based Psychotherapeutic Interventions. *J Technol Hum Serv.* 2008; 26: 109-60.

18. Grist R, Cavanagh K. Computerised Cognitive Behavioural Therapy for Common Mental Health Disorders, What Works, for Whom Under What Circumstances? A Systematic Review and Meta-analysis. *J Contemp Psychother.* 2013; 43: 243-51.

19. Wentzel J, van der Vaart R, Bohlmeijer ET, et al. Mixing Online and Face-to-Face Therapy: How to Benefit From Blended Care in Mental Health Care. *JMIR Ment Health*. 2016; 3: e9.

20. Leka S, Jain A, Iavicoli S, et al. The role of policy for the management of psychosocial risks at the workplace in the European Union. *Saf Sci.* 2011; 49: 558-64.

21. McDaid D, Park AL. Investing in mental health and well-being: findings from the DataPrev project. *Health Promot Int*. 2011; 26 Suppl 1: i108-39.

22. Kuster AT, Dalsbo TK, Luong Thanh BY, et al. Computer-based versus in-person interventions for preventing and reducing stress in workers. *Cochrane Database Syst Rev*. 2017; 8: CD011899.

23. Stratton E, Lampit A, Choi I, et al. Effectiveness of eHealth interventions for reducing mental health conditions in employees: A systematic review and meta-analysis. *PLoS One*. 2017; 12: e0189904.

24. Moreno C, Wykes T, Galderisi S, et al. How mental health care should change as a consequence of the COVID-19 pandemic. *Lancet Psychiatry*. 2020.

25. Wind TR, Rijkeboer M, Andersson G, et al. The COVID-19 pandemic: The 'black swan' for mental health care and a turning point for e-health. *Internet Interv.* 2020; 20: 100317.

26. Eichenberg C, Wolters C, Brahler E. The internet as a mental health advisor in Germany--results of a national survey. *PLoS One.* 2013; 8: e79206.

27. Musiat P, Goldstone P, Tarrier N. Understanding the acceptability of e-mental health--attitudes and expectations towards computerised self-help treatments for mental health problems. *BMC Psychiatry.* 2014; 14: 109.

28. Becker D. Acceptance of Mobile Mental Health Treatment Applications. *Procedia Comput Sci.* 2016; 98: 220-27.

29. Apolinario-Hagen J, Kemper J, Sturmer C. Public Acceptability of E-Mental Health Treatment Services for Psychological Problems: A Scoping Review. *JMIR Ment Health*. 2017; 4: e10.

30. Topooco N, Riper H, Araya R, et al. Attitudes towards digital treatment for depression: A European stakeholder survey. *Internet Interv.* 2017; 8: 1-9.

31. Apolinario-Hagen J, Harrer M, Kahlke F, et al. Public Attitudes Toward Guided Internet-Based Therapies: Web-Based Survey Study. *JMIR Ment Health*. 2018; 5: e10735.

32. Venkatesh, Morris, Davis, et al. User Acceptance of Information Technology: Toward a Unified View. *Mis Q.* 2003; 27.

33. Schuster R, Pokorny R, Berger T, et al. The Advantages and Disadvantages of Online and Blended Therapy: Survey Study Amongst Licensed Psychotherapists in Austria. *J Med Internet Res*. 2018; 20: e11007.

34. Dijksman I, Dinant GJ, Spigt M. The Perception and Needs of Psychologists Toward Blended Care. *Telemed J E Health.* 2017; 23: 983-95.

35. van der Vaart R, Witting M, Riper H, et al. Blending online therapy into regular face-to-face therapy for depression: content, ratio and preconditions according to patients and therapists using a Delphi study. *BMC Psychiatry.* 2014; 14.

36. Schuster R, Leitner I, Carlbring P, et al. Exploring blended group interventions for depression: Randomised controlled feasibility study of a blended computer- and multimedia-supported psychoeducational group intervention for adults with depressive symptoms. *Internet Interv.* 2017; 8: 63-71.

37. Mol M, van Genugten C, Dozeman E, et al. Why Uptake of Blended Internet-Based Interventions for Depression Is Challenging: A Qualitative Study on Therapists' Perspectives. *J Clin Med.* 2020; 9.

2. Effectiveness of occupational e-mental health interventions: a systematic review and meta-analysis of randomized controlled trials

2.1 Introduction

The importance of occupational mental health has grown notably during the last two decades (1). Increased demand for action on mental health promotion in the workplace is supported by evidence that the workplace and its environment have a significant influence on mental health and well-being (2). The workplace, where we spend approximately one-third of our adult lives, can either improve our mental well-being and mental stability or can contribute to the development of mental health problems (3). Same factors that can improve our psychological well-being, such as supportive leaders, cooperative coworkers, interesting work content, good work-life balance, high status of the occupation, and appropriate payment, in unfavorable situations may turn to stressors that can create sufficient strain to cause mental illness. Long working hours, low payment, occupational stress, discrimination, harassment, an unhealthy working environment, and many other risk factors that workplaces pose can negatively affect mental health (3).

Apart from the indisputable ethical value of individual well-being, there is a strong link between mental health and labor economics. Mental health conditions and illnesses are a serious cost-driver for healthcare systems globally, and they indirectly burden economies due to productivity losses. Employees' poor mental health can negatively affect productivity, manifesting in increased absenteeism and presenteeism, higher staff turnover, and reduced performance (4). In knowledge-based economies, employers rely on employees' learning, creativity and innovation capacities and are therefore interested not only in preventing mental health ill-

nesses but also in promoting positive mental health (5). Due to their flexible modes of delivery, low barriers to access, and cost-saving potential, e-mental health interventions are promising, particularly in the context of occupational health (6).

E-mental health is part of e-health, which is broadly described as "the use of information and communication technologies (ICT) for health" (7). According to this definition, the term e-mental health can be interpreted as the use of ICT technologies in the field of mental health. E-mental health interventions are often relatively short, they often involve self-help psychological treatments, and they are often based on established psychotherapy approaches such as cognitive behavioral theory; in addition, in recent years, they have been delivered via ICT, mostly through online platforms accessible via personal computers, tablets or smartphones (8, 9). One of the key components of an e-mental health intervention is the use of personal guidance through human contact and interaction expressed in a variety of forms such as e-mail or SMS reminders, feedback from a personal/online therapist or a coach, and peer/discussion support groups (10). Occupational e-mental health applies to the working population and can be defined as "the application of e-mental health in the specific life domain of work; its aims include improving the quality of working life and protecting and promoting the safety, health, and well-being of workers" (11).

The question of the effectiveness of e-mental health interventions in general has been addressed in several systematic reviews and meta-analyses. Barak et al. (12) found a moderate overall mean effect on mental health (Hedges' g=0.53, further noted as "g") for 9,764 patients from the general population, which is comparable to the average effect size of traditional, face-to-face therapy effectiveness of psychotherapeutic interventions. Grist et al. (13) showed in his meta-analysis of 49 studies that computerized cognitive behavioral therapy (CCBT) has a moderate to large effect (g=0.77) on clients with common mental health disorders. E-mental health interventions were found to be effective in reducing stress in a general population with

small to moderate effects. In another meta-analysis, Heber et al. (14) reported a small effect size for stress symptoms (Cohen's d=0.43, noted as "d" hereafter). Similar results were found by Jayawardene et al. (15) in their meta-analysis of the effectiveness of online mindfulness interventions, who found a small treatment effect (g=0.42), as well as by Spijkerman et al. (16), who found a moderate effect size (g=0.51). Moderate to large effect sizes (0.66<g<0.83) were also found for Internet-based interventions for posttraumatic stress (17). Computer-based treatments for depression were found to be effective with small [(g=0.29) (16), (d=0.32) (18), (d=0.34) (14), (d=0.41) (19)] to moderate effects (d=0.56) (20) in several meta-analyses. Smartphone-based e-mental health interventions for depression were found to be effective with a small effect (g=0.38) (21). Several meta-analyses demonstrated large effect sizes for e-mental health interventions addressing anxiety (d=0.96) (18), generalized anxiety disorder (d=- 0.91) (22) and social anxiety (*d*=0.86) (23). In another meta-analysis, Heber et al. (14) reported a small treatment effect on anxiety (d=0.32). Moderate effect sizes were also found for CCBT for insomnia (24). Overall, evidence suggests that e-mental health interventions are promising for reducing mental health conditions in the general population. There are differences in the effectiveness of e-mental health interventions across mental health conditions, and effects on stress, depression, and different anxiety conditions are particularly well investigated.

The evidence regarding occupational e-mental health is more limited. Kuster et al. (25) reviewed two studies with computer-based versus in-person stress management programs. The results of the review were conflicting, and the authors considered the studies to offer low-quality evidence. Stratton et al. (26) found a small pooled effect of e-mental health interventions on reducing depression, anxiety and stress conditions during the postintervention (g=0.24) and follow up (g=0.23) periods. The interventions were found to be effective for re-

ducing depression and stress with small effects; however, there was no evidence of their effectiveness in anxiety reduction. Carolan et al. (27) included 21 randomized control trials (RCTs) in a meta-analysis on psychological well-being consisting of studies on stress, anxiety and depression. The authors found a small, statistically significant posttreatment effect on psychological well-being (g=0.37) compared with the control condition.

Previous systematic reviews on e-mental health interventions for employees have revealed (pooled) effects on stress, depression and anxiety (26, 27). However, these reviews did not investigate how the effectiveness of e-mental health interventions vary across different mental health areas. Such negative psychological conditions as insomnia, burnout or alcohol misuse lead to a variety of negative organizational outcomes, including poor productivity and performance of employees (28). The question of whether occupational e-mental health interventions can be useful in these mental health domains has neither been addressed nor summarized in any other previous systematic reviews. The aim of this systematic review and meta-analysis was to address this question by broadening the focus of the review to every mental health area of occupational e-mental health interventions through a broad search strategy, performing a meta-analysis for each outcome and considering a broader set of moderators obtained from previous research.

2.2 Methods

2.2.1 Eligibility criteria

Studies were included if they reported on (i) RCTs evaluating (ii) the treatment efficacy (iii) of ICT-based interventions on (iv) any mental health condition in (v) an employee population for any occupation. The publication language was restricted to English. Our review included only RCTs as they provide the highest level of evidence because the random allocation of participants to study groups minimizes the influences of selection bias (29, 30). Studies with

other designs would not be fully comparable resulting in biased results of the meta-analysis, which additionally would have been difficult to interpret (30, 31). Following the Cochrane Handbook recommendations, we distinguished between inactive and active control-group designs (30). Accordingly, estimates of treatment effectiveness depend on a contrast between experimental conditions and counterfactual conditions that should be comparable (32). Studies with inactive control condition estimate absolute effects, whereas studies with active control designs estimate relative effects, showing whether a certain treatment is more effective than another (33). In our review, we aimed to investigate only the absolute treatment efficacy of the e-mental health interventions. For this purpose, we needed to account for the fact that effect sizes calculated from a mixed control group, containing both inactive and active control groups, may be blurred (32). To provide compelling evidence, we limited our selection to only studies with an inactive control condition (e.g., no treatment or a waiting list control) in the meta-analysis. As there were only a few studies with an active control condition per mental health outcome, it was not possible to include them as a separate subgroup. In studies with multiple arms, only the treatment and inactive control groups were included. Another inclusion criterion for the meta-analysis was reporting of validated outcomes with reliable validity tested in previous studies. Studies that used outcomes that did not meet these criteria were included only in the qualitative portion of this review (34, 35, 36). Articles were excluded from the analysis if they did not provide sufficient data to calculate pre-post effect sizes per condition and the author was unable to provide those data or did not respond to a request for the data (37, 38, 39).

2.2.2 Information sources and search strategy

Information sources

We followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standards (40). Three electronic databases (MEDLINE, PsycINFO, CINAHL) and three register trials (Cochrane Central Register of Controlled Trials, World Health Organization International Clinical Trials Registry Platform, US National Institutes of Health Ongoing Trials Register ClinicalTrials.gov) were searched on 1 December 2017. The search was updated on 23 April 2018. Citations from recent meta-analyses and systematic reviews were also reviewed. No time restrictions were set.

Search strategy

In the first step, we conducted a brief review using the terms e-health and mental health to identify mental health domains in which e-health solutions had been implemented to date. In the second step, we added the terms we identified in the first step to the search strategy: stress, depression, anxiety, burnout, insomnia, mindfulness, well-being, and alcohol misuse. A full description of the search terms, strategy and screening stages can be found in Appendix 2.A.

2.2.3 Study selection and data extraction process

Study selecion

Abstracts of potential studies were independently assessed by the author (EP) and coauthor (VG). Disagreements were discussed with the senior author (JS) until a consensus was reached.

Data extraction process

For each article, a systematic extraction form was used to collect the following data: 1) gen-

eral study information, design and setting; 2) participant characteristics; 3) type of recruitment; 4) intervention and control condition characteristics; 5) type of guidance; 6) outcome measures; 7) significant effects on mental health outcomes compared with the controls; and 8) overall study attrition rate. Table 1 in Appendix 2.B summarizes the characteristics of the extracted articles.

2.2.4 Assessment of methodological quality

The methodological appraisal of each study was independently conducted by two authors (EP, VG) with RoB 2.0, a revised tool used to assess the risk of bias in RCTs (41). Uncertainties were resolved through discussions with a third reviewer (JS). The following risk of bias domains were applied: (i) bias arising from the randomization process (selection bias); (ii) bias due to deviations from intended interventions (performance bias); (iii) bias due to missing outcome data (attrition); (iv) bias in measurement of the outcome (detection bias); and (v) bias in selection of the reported result (reporting bias). Following the Cochrane guidelines (41), we considered a study to have an overall "high risk of bias" when at least one of the bias domains was assessed to have a "high risk of bias". Publication bias was assessed for each model through the examination of funnel plots and Egger's regression tests (42). In addition, the trim-and-fill method was applied to identify studies responsible for asymmetry (43). Finally, to assess the robustness of a significant result, we calculated Orwin's fail-safe N, which indicates how many studies with effect size zero could be added to the meta-analysis to reduce the statistical significance. The results are considered robust if the fail-safe N is equal to or greater than 5n+10, where n is the number of studies (44).

2.2.5 Calculation of effect size and statistical analyses

For each study, between-group effect sizes were calculated for each outcome variable. Taking into consideration that our review also included studies with small sample sizes (<20) and accounting for recommendations for meta-analyses (45), Hedges' g was used to measure effect size at both the primary study and meta-analysis levels. To assess different sample sizes and pretest values, an effect size based on the mean pre-post change in the treatment group minus the mean pre-post change in the control group, divided by the pooled pretest standard deviation, was determined (46)2. Four studies did not provide standard deviations and means (47, 48, 49, 50). For one study (47), we used the effect size transformation formula and calculated Cohen's d from the eta-squared value and adjusted it for small sample bias (51). For three studies (48, 49, 50), we calculated the effect size using the p-values from the intention-to-treat (ITT) analysis. Effect sizes of $0.2 \leq g \leq 0.5$ were considered small, $0.5 \leq g \leq 0.8$ were considered medium, and $g \geq 0.8$ was considered large (52). A p value<0.05 was considered statistically significant. Positive effect sizes with a 95% confidence interval (95% CI) excluding zero indicated that the treatment condition was superior to the control condition. All meta-analyses were conducted in RStudio 1.1.447 using the package "metafor" (53).

2.2.6 Meta-regression

We used a random-effects model (RE) that accounts for differences in the treatment effects from heterogeneous studies. Eight separate meta-analyses were conducted for each mental health domain. In each analysis, mean effect sizes (Hedges' g), heterogeneity estimates (Q

[2] Morris compared effect size estimates in terms of bias, precision, and robustness to heterogeneity of variance and concluded that pretest standard deviation is a better choice because it represents the standard deviation of the untreated population, which is more likely to be consistent across studies (46).

statistic), and percentage of total variation across studies due to heterogeneity (I^2) were computed. We assessed degree of heterogeneity with a statistical significance level of $p<0.05$ as follows:

• 0% to 40% might not be important.

• 30% to 60% may represent moderate heterogeneity.

• 50% to 90% may represent substantial heterogeneity.

•75% to 100% equals considerable heterogeneity (54). Based on previous research, we hypothesized and tested whether the initial level of mental condition, guidance, type of recruitment, gender, and age of participants would moderate the treatment effects (10, 16, 20). We distinguished between two types of recruitment: workplace recruitment, when research teams and companies involved in the study cooperated directly, and publicly announced community recruitment for the general working population. Moderator analyses were conducted to examine whether the effect of an intervention could be explained by moderating variables. Potential moderators were selected based on theoretical considerations as well as on the insights gained from previous systematic and meta-analysis reviews. For example, previous research showed that participants' characteristics, such as gender, age, and education, as well as the initial level of mental condition of the participants; intervention characteristics, such as the existence of human support (guidance) and psychotherapy type; and study quality would moderate outcomes (10, 12, 16, 18, 19, 20, 26, 27, 55). In addition, a type of recruitment was coded based on observed methodological differences due to study settings and theoretical considerations that study settings may influence participants' motivation and compliance. We distinguished between two types of recruitment: workplace recruitment (when research teams and companies involved in the study cooperated directly) and publicly announced community recruitment for the general working population. Due to a lack of data, heterogeneity of variable

coding, as well as overall general dominance of the high education level in a sample, we excluded education from the moderator list. Based on an observation made in previous meta-analyses that the intervention type has a moderating role on the overall efficacy, we accounted for different psychotherapy types applied (16, 26) (56). For the moderator analysis, the Knapp and Hartung adjustment (57) was included to provide a conservative approach to moderation estimation, as the number of studies in the separate meta-analyses was relatively low.

2.3 Results

2.3.1 Study selection

We identified 3075 articles, 1633 of which were duplicates (Figure 1). In the next step, we excluded 1216 articles that did not meet our eligibility criteria. Of the 226 full-text articles retrieved, 50 met the inclusion criteria and were included in the review, 34 of which were included in the meta-analysis. We excluded ten studies with an active control condition, three because they did not report the validity of the measures used (34, 35, 36) and three because they did not provide sufficient data to calculate the pre-post effect size (37, 38, 39).

2.3.2 Study characteristics

The majority of the studies were performed in the USA (16), with a further ten performed in Germany, seven in Japan, five in the Netherlands, five in the UK, three in Sweden, and one each in Finland, Norway, Australia, and Hong Kong. The first study on computerized therapy was published in 1987 (50), and the majority of the studies (45) were published in the last five years, 2013-2017.

2.3.3. Participant characteristics

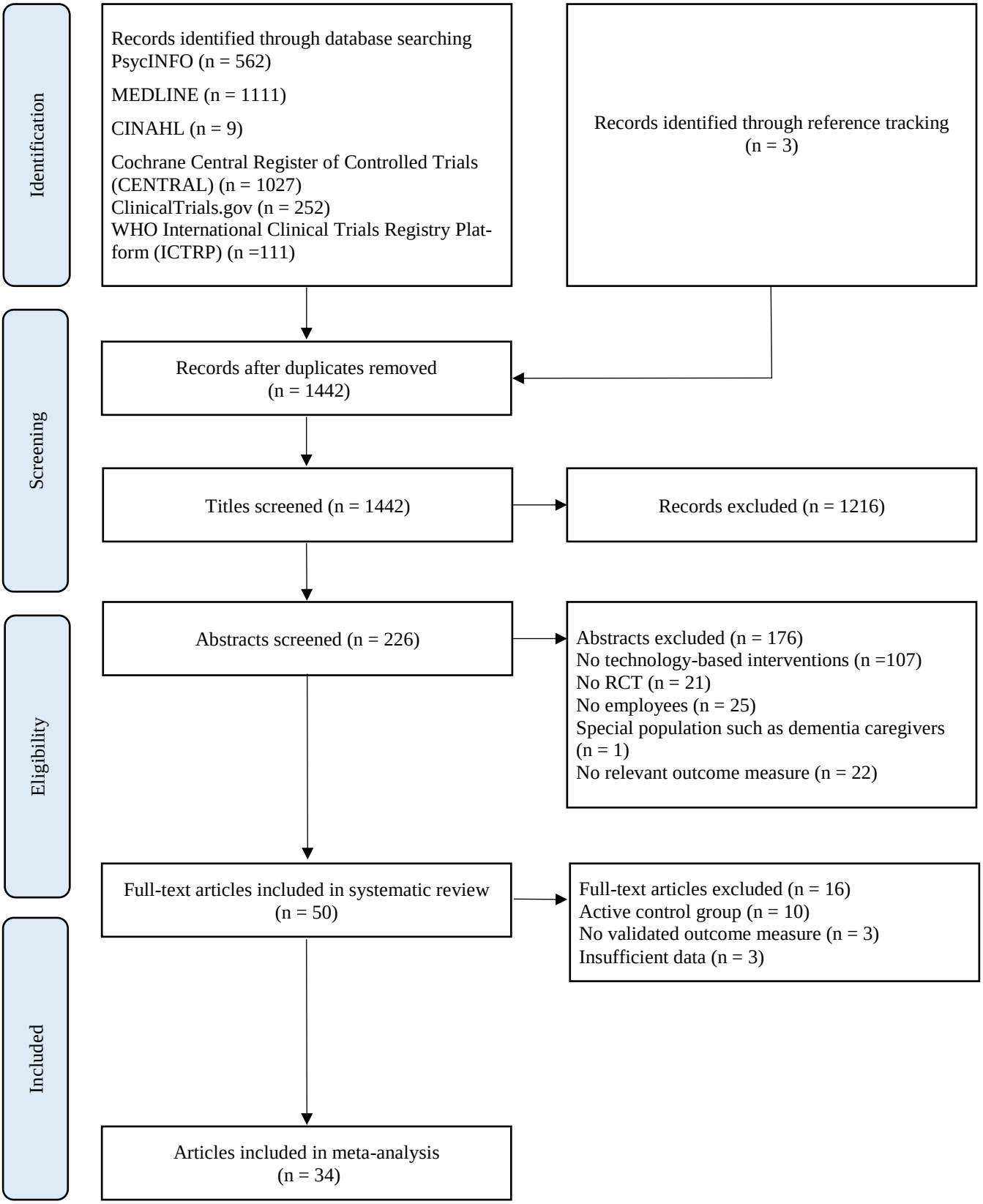
The total population included 15258 participants. The mean male gender rate was 47.4%, and the mean age was 41.8 years. Nineteen studies were conducted in a population with some symptoms of the treated condition. Most of the participants (68.7%) were highly educated with at least some years of university education. In cases in which recruitment was conducted in the workplace, the research teams cooperated with one company or several companies. It is striking that in studies with workplace recruitment settings, mainly knowledge-intensive occupational sectors were presented: information technology (7 companies), health care sector (6), education and research (3), communication and media (3), public sector (3), and consulting and banking (2). Only two studies on alcohol intake and stress reduction were conducted at worksites (34, 39). Full details of each study are displayed in Table B.1.

2.3.4 Intervention characteristics

The majority of interventions primarily addressed stress (18), while ten studies addressed depression, seven addressed insomnia and mental well-being, five focused on reducing alcohol consumption, and two studies were dedicated to burnout reduction. Three of the studies evaluated smartphone- or app-based interventions (47, 58). The majority of the studies (34) did not use guidance or personal contact. Studies with guidance provided different types of human support, e.g., regular calls by a clinical study officer, feedback from a clinical psychologist on home assignments, regular guidance from trained e-coaches, peer group discussions, and virtual class meetings. The level of guidance for each study is described in Table B.1. Thirty-one of the studies conducted recruitment in the workplace, while the remaining 20 studies used open community recruitment and announced their studies via mass media or by cooperating with professional labor organizations or health insurance companies. Treatment duration

ranged from brief interventions of 30 minutes (35) to 8 weeks (27, 59, 60). Some studies offered access to the intervention for three (61, 62, 63, 64), four (65) or six months (48) without specifying the intended treatment duration. The majority of e-mental health interventions (n=22) were based on cognitive behavioral therapy (CBT), some studies (n=7) gave normative personalized feedback on a treated mental condition, often as part of a general health check, while other studies used mindfulness training as a key treatment element (n=6), used psychoeducation (n=5), and the remaining studies used cognitive training (n=2), problem-solving training (n=2), positive psychology (n=2), and applications of Lazarus and Folkman's transactional theory (66) of stress and coping (n=2); each study involved resilience training, career identity training, and acceptance and commitment therapy (ACT). Ten of the studies reported offering some type of reward to enhance adherence and encourage participation, seven of which were from the USA.

Fig. 2-1: PRISMA flow chart of study selection



2.3.5 Comparison group

Thirty-four studies used a waitlist (or a waitlist with treatment as usual) as a control condition, and ten studies were conducted with an active control (AC) condition. Most of the studies with an AC condition used information about the treated mental issue offered via a website, regular e-mails or booklets as a control condition.

2.3.6 Outcomes

Fourteen studies did not define a primary outcome. Many studies with a primary outcome for one mental condition, e.g., stress, also considered depression, anxiety, or burnout as secondary outcomes. All studies used outcome measures with valid and reliable psychometric properties. The outcome measures for each study are provided in Table B.1. Three studies (34) (35, 36) were excluded from the meta-analysis because of unknown psychometric properties. For alcohol intake, a standard alcohol unit (SUA) of 10-12 grams of pure alcohol was selected as a common measure.

2.3.7 Quality of the studies

The overall evaluation of risk of bias for the included RCTs is presented in Table 2-1. The majority of the studies suffered from high attrition rates (greater than 20%), which is common for e-health interventions (11). We assessed the studies to be at high risk for missing outcome bias when the intervention arms had substantial differences in attrition or when one of the intervention arms had a dropout rate of more than 20%. All the included studies used patient self-reported measures and were therefore highly biased in the measurement of outcomes. Furthermore, only two studies blinded the participants so they were not aware of which type of trial they were involved in (67, 68). Because patients must play an active role in psycho-

therapeutic self-help interventions, it is difficult for researchers to implement effective blinding. For this reason, Berger (69) suggested not using the terms "controlled" or "evidence-based" for psychotherapy studies and introduced a new category for studies that cannot be double-blinded: "uncontrolled clinical data". According to this terminology, all the studies included in the current meta-analysis involved uncontrolled clinical data. Despite these two bias sources, which were relevant for almost all the studies, it was possible to identify a subgroup of studies for the moderator analysis that included studies that were judged as low on other bias domains. Ten of the 51 studies reported a conflict of interest whereby one of the authors had a financial interest in the tested e-mental health intervention.

Table 2-1: Risk of bias assessment of the included studies

Study	1	2	3	4	5	Study	1	2	3	4	5
Abbott et al., 2009 (81)	+	-	-	-	+	Imamura et al., 2014 (102)	+	-	-	-	+
Aikens et al., 2014 (82)	+	-	+	-	+	Imamura et al., 2016 (65)	+	-	+	-	+
Allexandre et al., 2016 (84)	+	-	-	-	+	Jonas et al., 2017 (83)	+	-	+	-	+
Billings et al., 2008 (61)	?	-	+	-	-	Ketelaar et al., 2013 (85)	+	-	-	-	?
Birney et al., 2016 (47)	+	-	+	-	?	Khadjesari et al., 2014 (68)	+	+	-	+	?
Bolier et al., 2013 (63)	+	-	-	-	+	Lappalainen et al., 2013 (86)	+	-	+	-	+
Borness et al., 2013 (37)	?	-	-	?	-	Ly et al., 2014 (58)	+	-	+	-	+
Boß et al., 2017 (76)	+	-	-	-	+	Matano et al., 2007 (34)	?	-	?	-	+
Bostock et al., 2016 (60)	+	-	-	-	+	Mori et al., 2014 (87)	+	-	+	-	+
Brendryen et al., 2017 (48)	+	-	-	-	+	Myers et al., 2017 (88)	+	?	-	?	+
Carolan et al., 2017 (27)	+	-	-	-	+	Neumeier et al., 2017 (89)	?	-	-	-	+
Cook et al., 2007 (62)	+	-	+	-	+	Persson et al., 2017 (90)	+	-	+	-	+
Cook et al., 2015 (64)	+	-	+	-	+	Phillips et al., 2014 (67)	+	+	-	-	+
Doumas et al., 2008 (35)	-	-	?	-	+	Querstret et al., 2017 (91)	+	-	+	-	+
Van Drongelen et al., 2014 (92)	+	-	+	-	+	Rexroth et al., 2017 (93)	?	-	-	-	+
Ebert et al., 2014 (78)	+	-	+	-	+	Ruwaard et al., 2007 (94)	+	-	-	-	+
Ebert et al., 2016a (79)	+	-	+	-	+	Shirotsuki et al., 2017 (95)	-	-	+	-	+
Ebert et al., 2016b (72)	+	-	+	-	+	Smith, 1987 (50)	?	-	?	-	-
Eisen et al., 2008 (39)	?	-	-	-	-	Taylor et al., 2017 (96)	+	-	+	-	+
Feicht et al., 2013 (97)	+	-	-	-	+	Suzuki et al., 2008 (99)	?	-	-	-	?
Geraedts et al., 2014a (98)	+	-	-	-	+	Thiart et al., 2015 (70)	+	-	+	-	+
Grime et al., 2014 (59)	-	-	-	-	+	Umanodan et al., 2014 (100)	?	-	+	-	+
Hasson et al., 2005 (49)	+	-	+	-	-	Wolever et al., 2012 (38)	?	-	-	-	+
Heber et al., 2016 (71)	+	-	+	-	+	Yamagishi et al., 2008 (36)	?	-	-	-	+
Hirsch et al., 2017 (101)	?	-	-	-	+	Yuan, 2015 (103)	+	-	?	-	?

Notes: 1 - bias arising from the randomization process; 2 - bias due to deviations from the intended interventions; 3 - bias due to missing outcome data; 4 - bias in measurement of the outcome; 5 - bias in selection of the reported result; "+" high risk of bias; "-" low risk of bias; "?" - unclear risk of bias.

2.3.8 Meta-analysis

The pre-post between-group effects for stress, depression, anxiety, burnout, insomnia, well-being, mindfulness, and alcohol intake for all the studies including outliers are presented in Table 2-2. Below, the results of the eight meta-analyses are discussed according to outcome measure.

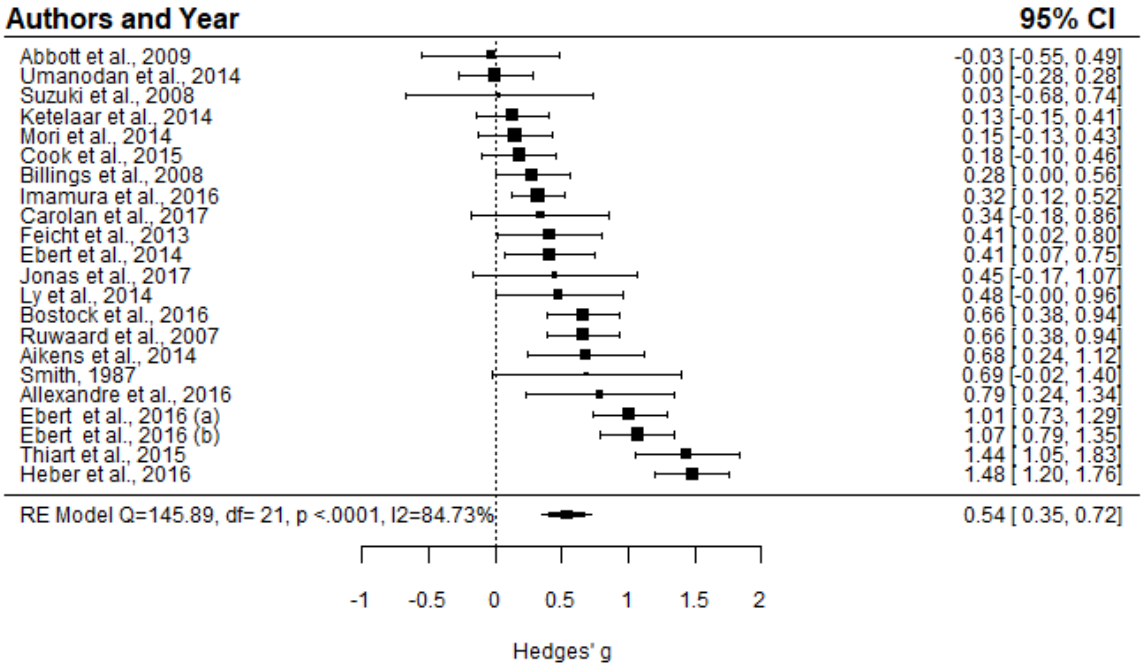
Table 2-2: Pre-post between-group effects for all outcomes including outliers

Outcome measures	N_{comp}	Hedge's g	95% CI	Q-value	I^2	Fail-Safe N
Stress	22	0.54	0.35-0.72	145.89***	84.73%	1635
Depression	17	0.30	0.18-0.42	40.10***	61.67%	285
Anxiety	15	0.34	0.18-0.50	51.90***	71.57%	259
Burnout	8	0.51	0.26-0.75	34.48***	79.16%	231
Insomnia	7	0.70	0.25-1.15	48.14***	91.88%	116
Well-being	7	0.35	0.25-0.46	8.99	0.01%	84
Mindfulness	5	0.42	0.24-0.60	4.03	0.00%	40
Notes: Ncomp, number of comparisons; CI, confidence interval. p<.05, * p<.01, ** p<.001 ***.						

Effects on stress

A pooled analysis of 22 RCTs using random effects demonstrated a medium effect for reducing perceived stress, with g=0.54 (95% CI: 0.35-0.72, p<0.0001) (Figure 2). However, the level of heterogeneity was high ($I^{2=}$84.73%). The omission of two outliers (70, 71) decreased the effect to g=0.44 (95% CI: 0.29-0.59, p<0.0001) and slightly reduced the heterogeneity ($I^{2=}$72.81%). No publication bias was identified.

Fig. 2-2: Forest plot of the effect sizes of e-mental health interventions on stress

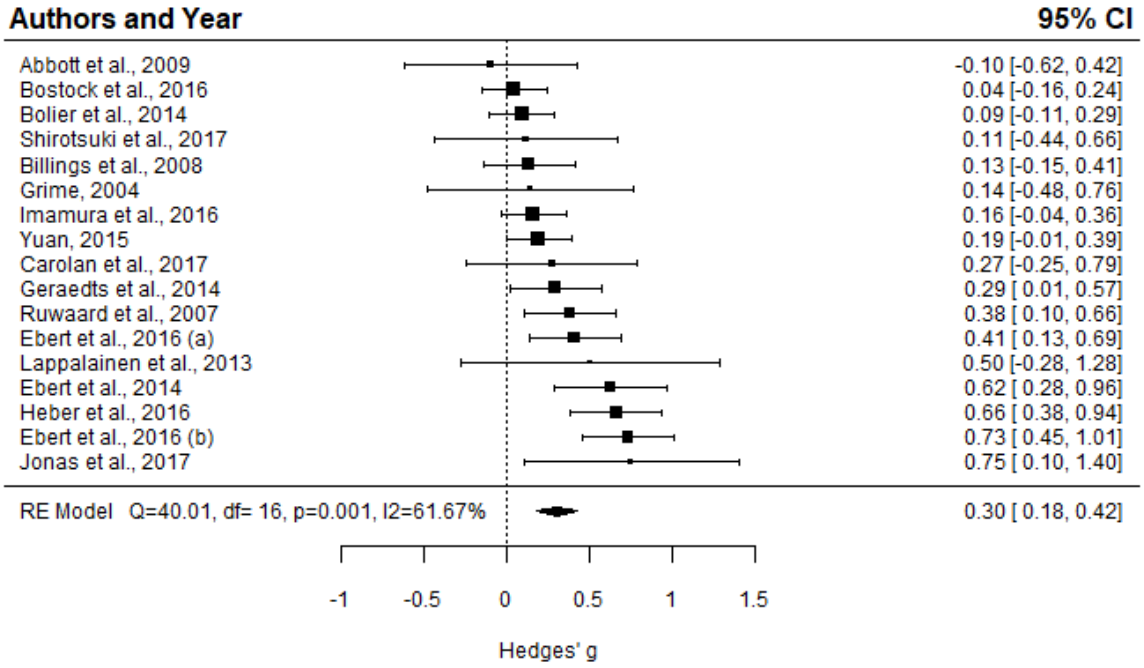


RE Model: random effects model, CI: confidence interval

Effects on depression

For the 17 studies with depression as an outcome, a small significant effect was observed (g=0.30, 95% CI: 0.18-0.42, p<0.0001) (Figure 3). The level of heterogeneity was substantial (I^2=61.67%), and one outlier was detected (72). After omitting this study from the analysis, the effect size dropped slightly to g=0.27 (95% CI: 0.16-0.38, p<0.0001), and the heterogeneity decreased to a moderate level (I^2=50.35%). No publication biases were detected.

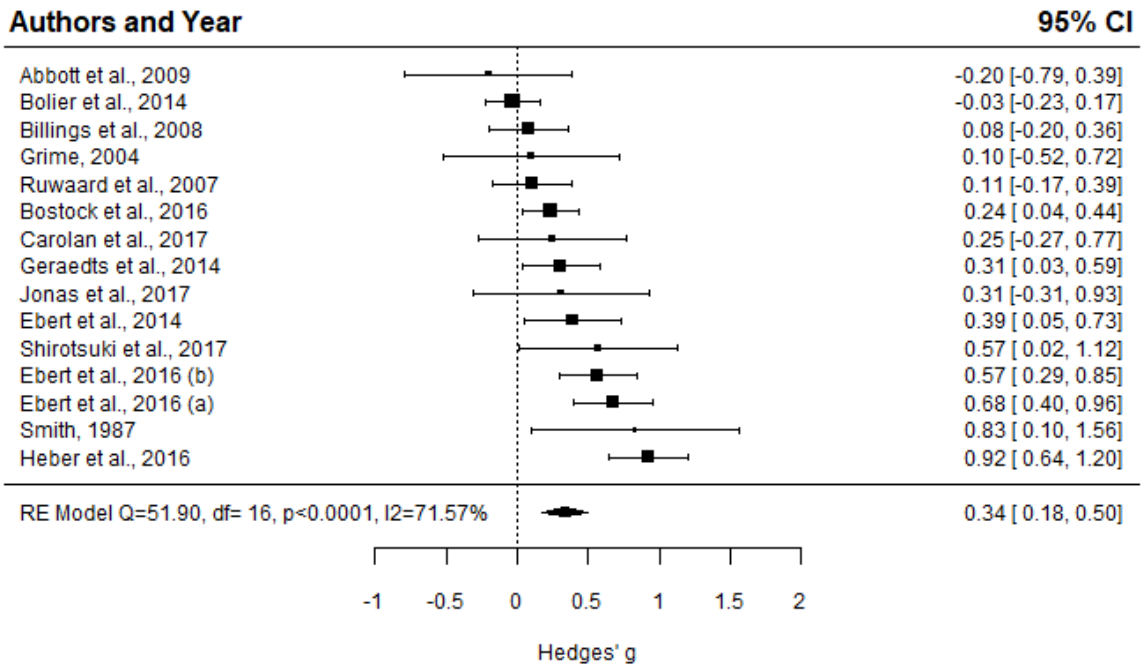
Fig. 2-3: Forest plot of the effect sizes of e-mental health interventions on depression



Effects on anxiety

A pooled analysis of 15 studies demonstrated a small effect on reducing anxiety (g=0.34; 95% CI: 0.18-0.50, p=0.0001) (Figure 4). The level of heterogeneity was high (I^2=71.57%), and one outlier was detected (71). After removing the outlier, the effect size dropped to g=0.28 (95% CI: 0.14-0-43, p<0.0001), but the heterogeneity remained in the moderate range (I^2=58.11%). No publication bias was detected.

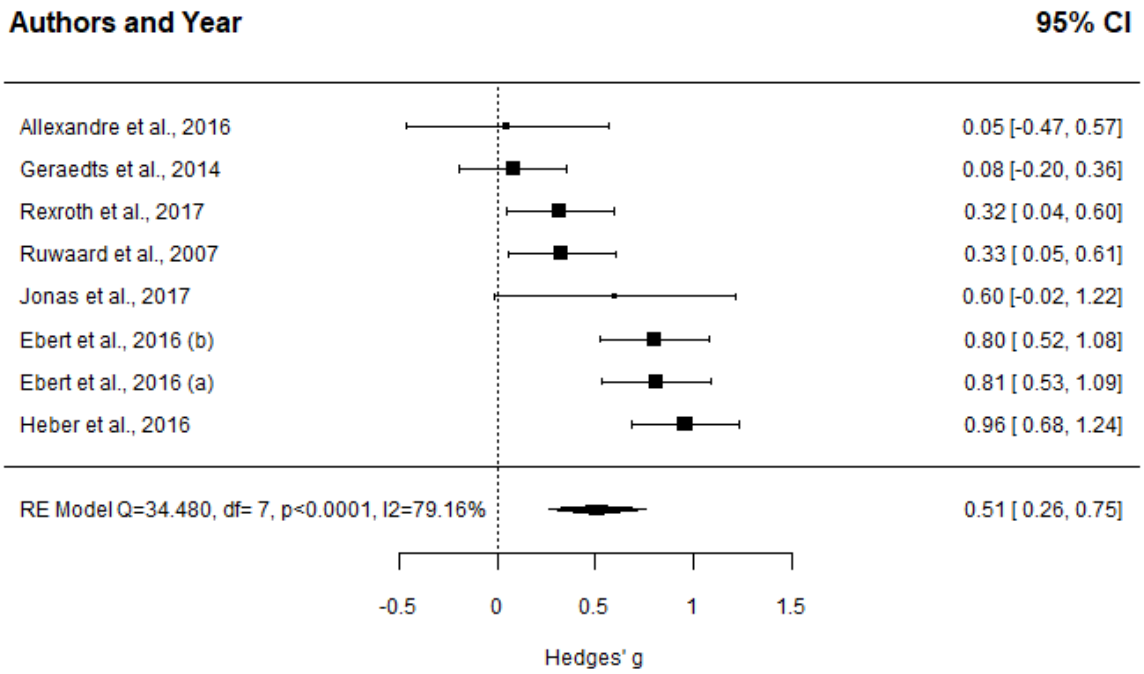
Fig. 2-4: Forest plot of the effect sizes of e-mental health interventions on anxiety



Effects on burnout

A significant moderate effect was found for the eight studies aiming to relieve burnout (g=0.51, 95% CI: 0.26-0.75, p<0.0001) (Figure 5). The level of heterogeneity was high (I^2=79.16%), and no outliers were detected.

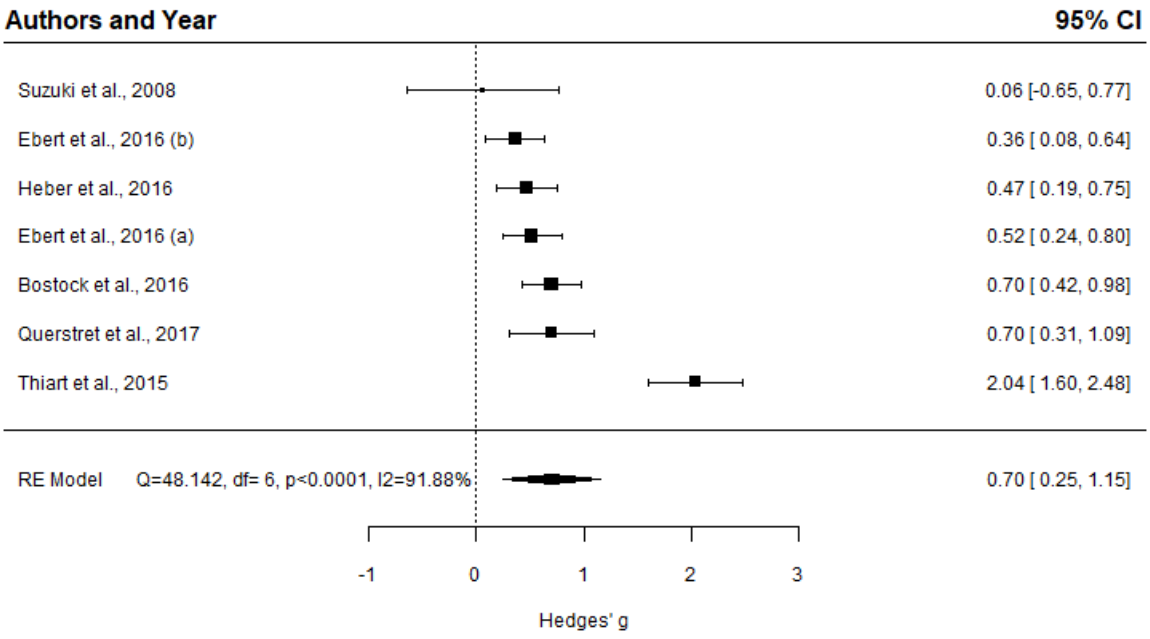
Fig. 2-5: Forest plot of the effect sizes of e-mental health interventions on burnout



Effects on insomnia

Based on seven studies, a significant moderate effect was found (g=0.70, 95% CI: 0.25-1.15, p=0.0022) (Figure 6). The level of heterogeneity was high (I^2=91.88%), and one outlier was found (70). After removing the outlier, the effect dropped to g=0.52 (95% CI: 0.39- 0.65, p<0.0001), and the heterogeneity decreased substantially (I^2=0.01%). Meta-regression analysis did not identify any relationship of potential moderators and effect size with insomnia. No publication biases were identified.

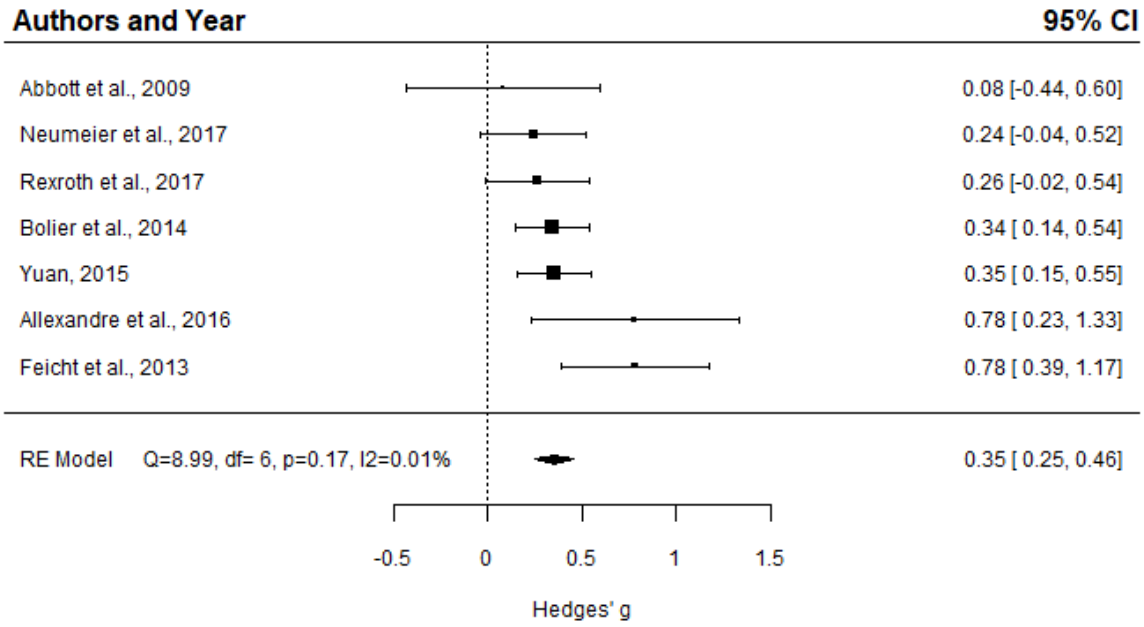
Fig. 2-6: Forest plot of the effect sizes of e-mental health interventions on insomnia



Effects on mental well-being

The overall mean effect size for 7 studies on well-being was g=0.35 (95% CI: 0.25-0.46, p<0.0001) (Figure 7). The level of heterogeneity was low (I^2=0.01%), and no outliers were detected. Using meta-regression analysis, we found no moderators for the pooled effect size. No publication biases were detected.

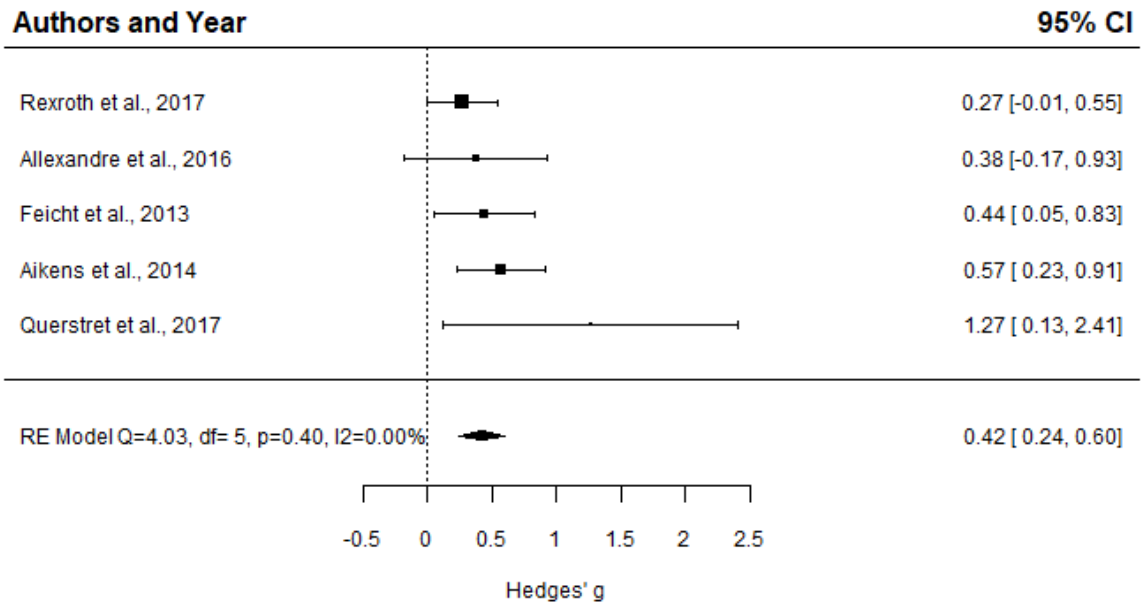
Fig. 2-7: Forest plot of the effect sizes of e-mental health interventions on well-being



Effects on mindfulness

For mindfulness (five studies), a significant, moderate effect was found (g=0.42, 95% CI: 0.24-0.60, p<0.0001) (Figure 8). The level of heterogeneity was low (I^2=0.00%). The meta-regression analysis did not reveal any significant moderators of the effect size. No publication biases were found.

Fig. 2-8: Forest plot of the effect sizes of e-mental health interventions on mindfulness



Effects on alcohol intake

The pooled analysis of two RCTs with passive control groups demonstrated a small but non-significant effect on reducing alcohol intake, with g=0.13 (95% CI: -0.23-0.48, p=0.488). The level of heterogeneity was low (I^2=0%); however, I^2 is imprecise and has substantial bias when the number of studies is small (73).

2.3.9 Meta-regression analysis

Based on the results of the meta-regression analysis, we found that workplace recruitment had a significant negative association with the intervention effects in stress (slope=-0.47, 95% CI: -0.80- -0.13, p=0.01), depression (slope=-0.31, 95% CI: 0.01-0.07, p=0.005), anxiety (slope=-0.33, 95% CI: -0.63- -0.02, p=0.04), and burnout (slope=-0.56, 95% CI: -1.03- -0.0, p=0.03). Age had a slightly positive influene on the effect size in e-mental health interventions for depression (slope=0.04, 95% CI: 0.01-0.07, p=0.005). An increased stress level among the participants demonstrated a positive significant association with the treatment effect (slope=0.55,

95% CI: 0.23-0.86, p=0.002). The presence of guidance moderated the treatment effect in stress-reducing interventions (slope=0.39, 95% CI: 0.03-0.75, p=0.04). Problem-solving therapy had a positive significant association with the treatment effect in cases of stress (slope=0.60, 95% CI: 0.15-1.04, p=0.01), depression (slope=0.35, 95% CI: 0.13-0.58, p=0.004), and anxiety (slope=0.40, 95% CI: 0.12-0.70, p=0.01). High study quality had a positive influence on the effect size in cases of depression (slope=0.34, 95% CI: 0.15-0.53, p=0.002), anxiety (slope=0.32, 95% CI: 0.07-0.62, p=0.046), and burnout (slope=0.61, 95% CI: 0.39-0.83, p=0.0005).

2.3.10 Subgroup analysis

Possible moderating effects can also be identified by explorative subgroup analyses (74) Exploratory subgroup analysis results are presented in Table 2-3. In the subgroups with open recruitment, significantly higher effects were found for stress, depression, anxiety, and burnout. In the subgroup participants older than 40, significantly higher effects were found for stress, depression, anxiety, and burnout. The presence of psychological symptoms significantly increased treatment effects in all mental health conditions. The presence of guidance and a higher quality of studies resulted in significantly higher treatment effects for interventions in all mental health areas (except well-being, where guidance was absent). The problem-solving therapy showed significantly higher treatment effects for stress, depression, anxiety, and burnout. For insomnia, significantly higher effects were achieved with mindfulness-based therapy.

Table 2-3: Subgroup analyses

Outcome measure	Criterion	Subgroup	N_{comp}	Hedge's g	95% CI	I^2 (%)
Stress	Recruitment type	Workplace	13	0.32***	0.18-0.47	49.76
		Community	9	0.79***	0.47-1.12	89.13
	Age	>40	10	0.76***	0.45-1.07	86.12
		<40	6	0.29**	0.08-0.49	63.40
	Initial mental condition	With	9	0.84***	0.55-1.13	87.49
		Without	13	0.27***	0.15-0.39	24.97
	Guidance	With	9	0.76***	0.44-1.08	85.83
		Without	13	0.38***	0.19-0.56	74.54
	Therapy type	CBT	11	0.40**	0.15-0.65	83.38
		Problem-Solving	4	1.00***	0.58-1.42	88.26
		Mindfulness	3	0.64***	0.36-0.92	0.00
		Positive Psychology	1	0.41*	0.02-0.80	0.00
		Others	3	0.19*	0.00-0.38	0.00
	Risk of bias	High	11	0.39***	0.24-0.54	45.53
		Low	11	0.67***	0.36-0.98	89.91
Depression	Recruitment type	Workplace	8	0.11*	0.007-0.22	0.00
		Community	9	0.45***	0.28-0.61	62.48
	Age	>40	10	0.47***	0.33-0.61	35.48
		<40	5	0.13*	0.02-0.24	0.00
	Initial mental condition	With	11	0.40***	0.21-0.53	62.33
		Without	6	0.20*	0.03-0.35	41.42
	Guidance	With	6	0.48***	0.33-0.63	0.00
		Without	11	0.23**	0.08-0.37	65.29
	Therapy type	CBT	9	0.18*	0.04-0.33	18.40
		Problem Solving	5	0.54***	0.37-0.70	41.15
		Positive Psychology	1	0.19	-0.00-0.39	0.00
		Others	2	0.13	-0.01-0.26	0.00
	Risk of bias	High	9	0.15***	0.061-0.24	0.00
		Low	7	0.52***	0.32-0.71	59.96
Anxiety	Recruitment type	Workplace	9	0.18	0.04-0.32	31.33
		Community	6	0.52***	0.27-0.76	72.06
	Age	>40	9	0.41***	0.20-0.62	69.71
		<40	4	0.16	-0.06-0.40	52.19
	Initial mental condition	With	9	0.42***	0.23-0.61	70.12
		Without	6	0.20	-0.04-0.44	59.13
	Guidance	With	5	0.48**	0.16-0.80	76.29
		Without	10	0.26	0.10-0.41	56.02
	Therapy type	CBT	8	0.18**	0.06-0.30	0.00
		Problem Solving	5	0.58***	0.37-0.79	63.81
		Others	2	0.32	-0.50-1.15	79.72
	Risk of bias	High	9	0.18*	0.04-0.31	30.41
		Low	6	0.50***	0.26-0.76	73.66
Burnout	Recruitment type	Workplace	2	0.07	-0.17-0.32	0.00
		Open Community	6	0.64***	0.40-0.87	71.17
	Age	>40	7	0.56***	0.30-0.80	79.78
		<40	1	0.05	-0.47-0.57	-
	Initial mental condition	With	6	0.60***	0.30-0.88	80.88
		Without	2	0.26*	0.02-0.50	0.00
	Guidance	With	4	0.69***	0.38-0.99	70.84
		Without	4	0.33	-0.01-0.68	79.08
	Therapy type	CBT	2	0.38**	0.12-0.63	0.00
		Problem Solving	4	0.66***	0.28-1.04	87.19

		Mindfulness	2	0.26*	0.02-0.50	0.00
	Risk of bias	High	4	0.23**	0.07-0.38	0.00
		Low	4	0.84***	0.69-1.0	0.00
Insomnia	Recruitment type	Workplace	1	0.70***	0.42-0.97	0.00
		Community	6	0.70*	0.16-1.24	92.91
	Age	>40	5	0.80**	0.21-1.40	94.14
		<40	2	0.47	-0.14-1.07	63.38
	Initial mental condition	With	5	0.80**	0.22-1.39	94.78
		Without	2	0.45	-0.16-1.06	58.5
	Guidance	With	3	1.00*	0.00-1.99	96.55
		Without	4	0.53	0.30-0.76	39.98
	Therapy type	CBT	3	0.95	-0.18-2.08	94.86
		Problem Solving	3	0.45***	0.29-0.61	0.00
		Mindfulness	1	0.70***	0.30-1.09	0.00
	Risk of bias	High	2	0.47	-0.14-1.07	63.38
		Low	5	0.80**	0.21-1.40	94.14
Well-being	Recruitment type	Workplace	4	0.48**	0.18-0.78	58.91
		Community	3	0.30***	0.16-0.44	0.00
	Age	>40	3	0.23*	0.05-0.41	0.00
		<40	2	0.53*	0.11-0.95	72.96
	Initial mental condition	With	-	-	-	-
		Without	7	0.35***	0.25-0.46	0.01
	Guidance	With	-	-	-	-
		Without	7	0.35***	0.25-0.46	0.01
	Therapy type	Positive Psychology	3	0.42**	0.15-0.69	65.23
		Mindfulness	2	0.46	-0.03-0.96	63.02
		Others	2	0.30	0.12-0.49	0.00
	Risk of bias	High	7	0.35***	0.25-0.46	0.01
		Low	-	-	-	-
Mindfulness	Recruitment type	Workplace	3	0.49***	0.26-0.72	0.00
		Community	2	0.61	-0.32-1.54	64.00
	Age	>40	2	0.61	-0.32-1.54	64.00
		<40	2	0.42*	0.10-0.74	0.00
	Initial mental condition	With	-	-	-	-
		Without	5	0.42***	0.24-0.60	0.00
	Guidance	With	1	0.57***	0.23-0.90	0.00
		Without	4	0.36***	0.16-0.57	0.01
	Therapy type	Mindfulness	4	0.43***	0.20-0.66	17.14
		Positive Psychology	1	0.44*	0.05-0.83	-
	Risk of bias	High	2	0.33**	0.10-0.55	0.00
		Low	3	0.56***	0.28-0.84	0.01

2.4 Discussion

To our knowledge, this systematic review with meta-analyses is the first that evaluated e-mental health interventions for every mental health condition in an occupational context. We found statistically significant moderate effects on stress, insomnia and burnout and small treatment effects on depression, anxiety, well-being, and mindfulness compared with control groups with inactive control conditions. The meta-analyses of alcohol intake consisted of only two studies, and the effect on alcohol intake was small and nonsignificant.

From the 22 studies on stress included in the meta-analysis, it is evident that stress is the most widespread and growing concern for organizations and is the most common area of application of occupational e-mental health interventions. The significant moderate effect (g=0.54) on stress reduction is comparable to the findings of previous research conducted in the general population (16). The omission of two outliers (71, 70) decreased the effect (from g=0.54 to g=0.44), in accordance with the results of previous meta-analyses in the general population (14, 15). Community recruitment significantly enhanced the treatment effect (g=0.79), while workplace recruitment decreased the intervention effect. The positive treatment effect was significantly increased to a large effect size by the presence of guidance (g=0.76) and initial stress level (g=0.84). Problem-solving therapy also significantly increased the treatment effect (g=1.0).

For depression, we noted a small significant effect (g=0.30) when analyzing 17 studies. After omitting the outlier, the effect size slightly dropped (g=0.27), in accordance with the results of previous research in the general population (14, 16, 18, 19). As in the previous case, the effect size increased to a moderate size (g=0.52) in the subgroup with community recruitment. Higher participant age and better study quality slightly enhanced the effect sizes to g=0.45 and g=0.52, respectively.

In the case of anxiety, we analyzed 15 studies and found a small treatment effect (g=0.34),

and the effect slightly dropped after the omission of the outlier (g=0.28). This result corresponds to the results of the meta-analysis in the general population conducted by Heber et al. (14), while some previous systematic reviews reported large treatment effects on anxiety (18, 56) in the general population. However, it should be noted that anxiety was not a primary therapeutic target in all 15 interventions included in the meta-analyses on anxiety but was considered to be a secondary outcome in interventions on stress and/or depression. Similar moderating patterns were observed as in previous cases. The effect of the treatment was enhanced by community recruitment (g=0.52), problem-solving therapy (0.58), and the quality of the studies (g=0.50).

For burnout, after analyzing eight studies, we found a moderate effect size (g=0.51) with the same moderators as described earlier, namely, community recruitment (g=0.64) and quality of studies (g=0.84). Our findings are similar to those from the latest RCT on burnout in the general population, in which moderate to large effects for burnout were found (75).

The meta-analyses of insomnia (seven studies), mental well-being (seven studies) and mindfulness (five studies) showed a moderate effect for insomnia (g=0.70), a small effect for mindfulness (0.42) and a small effect for mental well-being (g=0.35). The effectiveness research on reducing insomnia symptoms in the general population in a previous meta-analysis showed a moderate effect (24). Previous meta-analyses in the general population also demonstrated small effects for well-being and small effects for mindfulness (15, 16). The five studies on alcohol intake reported conflicting results. Two studies on alcohol intake reported small treatment effects (48, 76), while two other studies did not use comparable measures and reported improvements only for binge drinking and consumption reduction (34, 35). The fifth study (68) reported the opposite effect, namely, higher alcohol consumption in the intervention group. The pooled effect of the two studies on alcohol intake included in the meta-anal-

yses was small and nonsignificant. Although current research findings regarding online interventions show improvements in drinking behavior in the general population (77), we recommend a meta-analysis that includes more comparisons to better estimate the effectiveness of e-health interventions on alcohol intake in the occupational context.

From the point of view of study design, we noted that open community recruitment enhances the treatment effect. This finding could be explained by the fact that participants who volunteer for community recruitment have a stronger intrinsic motivation and typically do not experience external expectations, e.g., compliance with internal procedures in a workplace environment.

Age moderated the effect on depression, and the subgroups with older participants showed significantly higher effects for stress, depression, and burnout. The enhancing role of older participants was previously shown (77) and could be explained by the higher self-disciplined engagement of participants that is required by most self-help interventions. However, this finding should be interpreted with caution, as RCTs in younger participants in an occupational context are rare. Thus, we recommend that future research should include different age groups or directly address young employees to close the research gap.

The initial level of psychological symptoms moderated the effect on stress, and analyses of subgroups showed the same tendency for all mental health conditions. Healthy populations usually have less room for improvement and, therefore, produce smaller treatment effect. This tendency was also previously reported in reviews on e-health interventions (12, 26).

The fact that guided e-health interventions yield better outcomes was already widely investigated in previous research (10, 18, 20). Our explanatory subgroup analyses also confirmed the advantage of the guidance for all mental health areas. However, the subgroup analyses were underpowered and should be interpreted accordingly.

Problem-solving therapy showed a significant moderating effect on effectiveness in cases of stress, depression, anxiety, and burnout; however, this result should be interpreted cautiously, as four of the six studies involving problem-solving therapy in the whole sample were performed by the same investigation team, which could cause a risk of author bias (71, 72, 78, 79). The subgroup analyses indicated that mindfulness and positive psychology also lead to higher effect sizes, in accordance with findings by other researchers (26). Our findings suggest the need to further investigate the effectiveness of these therapy approaches, as they appear superior to CBT according to our results. The education level of participants was predominantly high, so we could not assess its moderating effect due to homogeneity of the sample. Gender did not show any moderating effects on treatment effect.

Study quality had a moderating effect on depression, anxiety, and burnout. Subgroup analysis showed higher treatment effects in studies with a low bias risk in all mental health areas. A correlation between higher study quality and higher effect size could be explained with a larger range of those studies, careful design including systematic randomization approaches applied as well as low attrition rates that lowered the risk of bias in the quality assessment.

2.5 Limitations

Our meta-analysis has several limitations. Although we identified 35 studies for the meta-analysis, we analyzed the effects per outcome, and some outcome groups consisted of only a few studies (e.g., only two studies covered alcohol intake). Some subgroup analyses covered a small number of studies, so it should be acknowledged that these analyses are underpowered, and the findings should therefore be interpreted with caution. While excluding outliers reduced heterogeneity among the studies, I^2 remained large for some outcomes, implying a persistent heterogeneity among the studies that cannot be explained by this analysis. All studies

were assessed as high risk due to the absence of blinding and self-reported outcomes; this absence is particularly important, as the absence of blinding may cause placebo effects in mental health studies. The majority of studies used a waitlist as a control condition, which may provoke nocebo effects. The status of waiting for a future treatment may weaken patients' efforts to get better on their own initiative compared with natural conditions. Due to this fact, waitlist design studies can provide inaccurate estimates, resulting in stronger treatment effects (79). Approximately one-third of the articles for some outcomes (e.g., insomnia and burnout) were written by the same investigation team, which may cause author bias. High dropout rates (more than 20%) are another common problem of e-health intervention studies, and this was reinforced by the present review; more than half of the studies (25) suffered from high attrition rates, while five studies did not report on attrition. Thus, it was impossible to appraise the bias associated with missing outcome data. Due to the heterogeneity of the studies, it was not possible to assess the actual amount of treatment and its role on effectiveness, as it was not reported consistently. Certain studies spanned weeks, some offered sessions or modules, and many did not report the extent of the treatment. Finally, the majority of the participants were highly educated at the university level, rendering the results less generalizable for other professional groups.

2.6 Conclusions

Based on the results discussed, we can conclude that e-mental health interventions can significantly improve mental health conditions in an occupational context with small to moderate treatment effects. Previous systematic reviews on employee population reported significant mental health improvements with small overall effects for stress, depression, and anxiety (26, 27). Higher moderate treatment effects were achieved for stress, insomnia, and burnout. These findings could potentially be explained by the lower degree of stigmatization linked to stress,

sleep problems, or burnout than the stigmatization linked to mental health conditions that are closer to a clinical diagnosis of mental health disorder, such as depression, anxiety and alcoholism. This insight could be important for interventions conducted directly at the workplace. The hypothesis that interventions addressing less stigmatized mental health areas could lead to better treatment effects in an occupational setting should be examined in further studies. This insight could be important for interventions conducted directly at the workplace. Furthermore, the hypothesis that open community recruitment enhances the treatment effect should be tested. As an implication for practitioners, we recommend taking advantage of community recruitment settings, namely, by providing maximum voluntary data security and anonymity and time resources for the treatment for interventions conducted directly at the workplace. From a methodological point of view, we recommend testing the effectiveness of e-mental health interventions using objective outcomes such as biological markers so outcome assessment bias can be avoided. This approach would increase the evidence in this field. The effectiveness of e-mental health interventions should also be tested in less knowledge-based occupational sectors to determine whether occupational e-mental health interventions are effective for workers with lower education levels and for younger people and to examine how such interventions work for a more digital-savvy generation.

2.7 References

1. Riba, M.B., Parikh, S.V., & Greden, J.F. (2019). Mental health in the workplace: Strategies and tools to optimizes outcomes. (1st ed.) Cham: Springer Nature Switzerland AG.

2. Leka, S., Jain, A., Iavicoli, S., Vartia, M., & Ertel, M. (2011). The role of policy for management of psychosocial risks at the workplace in the European Union. *Safety Science*, 49(4), 558-564.

3. Thomas, J.C. & Hite, J. (2002). Mental health in the workplace: Toward an integration of organizational and clinical theory, research, and practice. In Hersen, M. & Thomas, J.C. (Eds.). *Handbook of mental health in the workplace*. Thousand Oaks, London, New Delhi: Sage Publications, 3-15.

4. Goetzel, R.Z., Long, S.R., Ozminkowski, R.J., Hawkins, K., Wang, S., & Lynch, W. (2004). Health, absence, disability, and presenteeism cost estimates of certain physical and mental health conditions affecting U.S. employers. *J Occup Environ Med*, 46(4), 398-412.

5. Greden, J.F., Garcia-Tosi, R., & White Harrington, A. (2019). Healthy minds at work: Challenges and strategies for businesses. In Riba, M.B., Parikh, S.V., & Greden, J.F. (Eds.). *Mental health in the workplace: strategies and tools to optimizes outcomes*. (1st ed). Cham: Springer Nature Switzerland AG, 1-16.

6. Qu, C. & Ozersky, S. (2019). Workplace Mental Health in Canada: Towards a digital Future. In Riba, M.B., Parikh, S.V., & Greden, J.F. (Eds.). *Mental health in the workplace: strategies and tools to optimizes outcomes*. (1st ed). Cham: Springer Nature Switzerland AG, 27-44.

7. World Health Organization. (1996). *WHOQOL-BREF: Introduction, administation, scoring and generic version of the assessment: Field trial version*. Geneva: WHO.

8. Christensen, H. & Hickie, I.B. (2010). Using e-health applications to deliver new mental health services. *Med J Aust*, 192(11), 53-56.

9. Ebert DD, Erbe D. Internetbasierte psychologische Interventionen. In: Rief W, Berking M, eds. *Klinische Psychologie und Psychotherapie.* Springer; 2012: 131-140.

10. Baumeister, H., Reichler, L., Munzinger, M., & Lin, J. (2014). The impact of guidance on internet-based mental health interventions - a systematic review. *Internet Interventions*, 1(4), 205-215.

11. Lehr, D., Geraedts, A., Persson Asplund, R., Khadjesari, Z., Heber, E., de Bloom, J., et al. (2016). Occupational e-Mental health: current approaches and promising perspectives for

promotin mental health in workers. In Cacace, M., Fischer, S., & Wiencke, M. (Eds.). *Healthy at work: Interdisciplinary perspectives*. Cham: Springer International Publishing, 257-281.

12. Barak, A., Liat, H., Boniel-Nissim, M., & Shapira, N. (2008). A comprehensive review and a meta-analysis of the effectivness of internet-based psychotherapeutic interventions. *J Tech Hum Serv*, 26(2-4), 109-160.

13. Grist, R. & Cavanagh, K. (2011). Computerised cognitive behavioural therapy for common mental health disorders, what works, for whom under what circumstances? A systematic review and meta-analysis. *J Contemp Psychother*, 43(4), 243-251.

14. Heber, E., Ebert, D.D., Lehr, D., Cuijpers, P., Berking, M., Nobis, S., et al. (2017). The benefit of web- and computer-based interventions for stress: a systematic review and meta-analysis. *J Med Internet Res*, 19(2), e32.

15. Jayawardene, W.P., Lohrmann, D.K., Erbe, R.G., & Torbi, M.R. (2017). Effects of preventive online mindfulness interventions on stress and mindfulness: a meta-analysis of randomized controlled trials. *Prev Med Rep*, 5, 150-159.

16. Spijkerman, M.P., Pots, W.T., & Bohlmeijer, E.T. (2016). Effectiveness of online mindfulness-based interventions in improving mental health: a review and meta-analysis of randomised controlled trials. *Clin Psychol Rev*, 45, 102-114.

17. Kuester, A., Niemeyer, H., & Knaevelsrud, C. (2016). Internet-based interventions for posttraumatic stress: a meta-analysis of randomised controlled trials. *Clin Psychol Rev*, 43, 1-16.

18. Spek, V., Cuijpers, P., Nyklicek, I., Riper, H., Keyzer, J., & Pop, V. (2007). Internet-based cognitive behaviour therapy for symptoms of depresion and anxiety: a meta-analysis. *Psychol Med*, 37(3), 319-328.

19. Andersson, G. & Cuijpers, P. (2009). Internet-based and other computerized psychological treatments for adult depression: a meta analysis. *Cogn Behav Ther*, 38(4), 196-205.

20. Richards, D. & Richardson, T. (2012). Computer-based psychological treatments for depression: a systematic review and meta-analysis. *Clin Psychol Rev*, 32(4), 329-342.

21. Firth, J., Torous, J., Nicholas, J., Carney, R., Pratap, A., Rosenbaum, S., et al. (2017). The efficacy of smartphone-based mental health interventions for depressive symptoms: a meta-analysis of randomized controlled trials. *World Psychiatry*, 16(3), 287-298.

22. Richards, D., Richardson, T., Timulak, L., & McElvaney, J. (2015). The efficacy of internet-delivered treatment for generalized anxiety disorder: a systematic review and meta-analysis. *Internet Interventions*, 2(3), 272-282.

23. Tulbure, B.T. (2011). The efficacy of internet-supported intervention for social anxiety disorder: a brief meta-analytic review. *Procedia Soc Behav Sci*, 30, 552-557.

24. Cheng, S.K. & Dizon, J. (2012). Computerised cognitive behavioural therapy for insomnia: a systematic review and meta-analysis. *Psychother Psychosom*, 81(4), 206-216.

25. Kuster, A.T., Dalsbø, T.K., Luong Thanh, B.Y., Agarwal, A., Durand-Moreau, Q.V., & Kirkehei, I. (2017). Computer-based versus in-person interventions for preventing and reducing stress in workers. *Cochrane Database Syst Rev*, 8.

26. Stratton, E., Lampit, A., Choi, I., Calvo, R.A., Harvey, S.B., & Glozier, N. (2017). Effectiveness of e-health interventions for reducing mental health conditions in employees: a systematic review and meta-analysis. *PLoS One*, 12, 12.

27. *Carolan, S., Harris, P.R., Greenwood, K., & Cavanagh, K. (2017). Increasing engagement with an occupational digital stress management program through the use of an online facilitated discussion group: results of a pilot randomised controlled trial. *Internet Interventions*, 10, 1-11.[3]

28. Thomas, J.C. & Hersen, M. (2002). *Handbook of mental health in the workplace*. Thousand Oaks, London, New Dehli: Sage Publications.

29. Odgaard-Jensen, J., Vist, G.E., Timmer, A., Kunz, R., Akl, E.A., Schünemann, H., et al. (2011). Randomisation to protect against selection bias in healthcare trials. *Cochrane Database Syst Rev*, 4.

30. Higgins, J.P.T. & Green, S. (2001). *Cochrane handbook for systematic reviews of interventions*. (5.1.0.). Oxford: The Cochrane Collaboration.

31. Peinemann, F., Tushabe, D.A., & Kleijnen, J. (2013). Using multiple types of studies in systematic reviews of health care interventions - a systematic review. *PLoS One*, 26(8), e85035.

32. Karlsson, P. & Bergmark, A. (2015). Compared with what? An analysis of control-group types in Cochrane and Campbell reviews of psychosocial treatment efficacy with substance use disorders. *Addiction*, 110, 420-428.

33. Makuch, R.W. & Johnson, M.F. (1989). Dilemmas in the use of active control groups in clinical research. *IRB: Ethics & Human Research*, 11(1), 1-5.

34. *Matano, R.A., Koopman, C., Wanat, S.F., Winzelber, A.J., Whitsell, S.D., Westrup, D., et al. (2007). A pilot study of an interactive web site in the workplace for reducing alcohol consumption. *J Subst Abuse Treat*, 32(1), 71-80.

[3] Publications marked with asterisk (*) are included in the systematic-review and meta-analysis

35. *Doumas, D.M. & Hannah, E. (2008). Preventing high-risk drinking in youth in the workplace: a web-based normative feedback program. *J Subst Abuse Treat*, 34(3), 263-271.

36. *Yamagishi, M., Kobayashi, T., & Nakamura, Y. (2008). Effects of web-based career identity training for stress management among Japanese nurses: a randomized control trial. *J Occup Health*, 50(2), 191-193.

37. *Borness, C., Proudfoot, J., Crawford, J., & Valenzuela, M. (2013). Putting brain training to test in the workplace: a randomized, blinded multisite, active-controlled trial. *PLoS One*, 8, 3.

38. *Wolever, R.Q., Bobinet, K.J., McCabe, K., Mackenzie, E.R., Fekete, E., Kusnick, C.A., et al. (2012). Effective an viable mind-body stress reduction in the workplace: a randomized controlled trial. *J Occup Health Psychol*, 17(2), 246-258.

39. *Eisen, K.P., Allen, G.J., Bollash, M., & Pescatello, L.S. (2008). Stress management in the workplace: a comparison of a computer-based and an in-person stress-management intervention. *Comput Human Behav*, 24(2), 486-496.

40. Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G., & The PRISMA Group. (2009). Preferred reporting items for systematic reviews and meta-analyses: The PRISMA Statement. *PLoS*, 6(7), e1000097.

41. Higgins, J.P.T., Sterne, J.A.C., Savović, J., Page, M.J., Hróbjartsson, A., Boutron, I., et al. (2016). Revised tool for assessing risk of bias in randomized trials. *Cochrane Database Syst Rev*, 10(1), 29-31.

42. Sterne, J. & Egger, M. (2005). Regression methods to detect publication and other bias in meta-analysis. In Suton, A.J., Borenstein, M., & Rothstein, H.R. *Publication bias in meta-analysis: prevention, assessment, and adjustments*. Chichester: John Wiley & Sons, 99-110.

43. Duval, S. & Tweedie, R. (2000). Trim and fill: A simple funnel-plot-based method of testing and adjusting for publicaiton in bias in meta-analysis. *Biometrics*, 56, 455-463.

44. Orwin, R. (1983). A fail-safe N for effect size in meta-analysis. *J Educ Behav Stat*, 8(2), 157-159.

45. Elis, P. (2010). *The essential guide to effect sizes: Statistical power, meta-analysis, and the interpretation of research results*. Cambride: Cambridge University Press.

46. Morris, S.B. (2008). Estimating effect sizes from pretest-posttest-control group designs. *Organizational Market Research*, 11(2), 364-386.

47. *Birney, A.J., Gunn, R., Russell, J.K., & Ary, D.V. (2016). MoodHacker mobile web app with email for adults to self-manage mild-to-moderate depression: Randomized controlled trial. *JMIR Mhealth Uhealth*, 4(1), e8.

48. *Brendryen, H., Johansen, A., Duckert, F., & Nesvag, S. (2017). A pilot randomized controlled trial of an internet-based alcohol intervention in a workplace setting. *Int J Behav Med*, 24(5), 768-777.

49. *Hasson, D., Anderber, U.M., Theorell, T., & Arnetz, B.B. (2005). Psychophysiological effects of a web-based stress management system: a prospective, randomized controlled intervention of study of IT and media workers. *BMC Public Health*, 78(5).

50. *Smith, J.J. (1987). The effectiveness of a computerized self-help stress coping program with adult males. *Computers in Human Services*, 2(1-2), 37-49.

51. Hedges, L. & Olkin, I. (1985). *Statistical methods for meta-analysis*. New York: Academic Press.

52. Cohen, J. (1988). *Statistical power analysis for the behavioral sciences*. (2nd ed.). Hillsdale, NJ: Erlbaum.

53. Viechtbauer, W. (2010). Conducting meta-analyses in R with the metafor package. *J. Stat. Softw.*, 36(3), 1-48.

54. Higgins, J.P.T., Thompson, S.G., Deeks, J.J., & Altman, D.G. (2003). Measuring inconsistency in meta-analyses. *BMJ*, 327, 557-560.

55. Cowpertwait, L. & Clarke, D. (2013). Effectiveness of web-based psychological interventions for depression: a meta-analysis. *Int J Ment Health Addict*, 11(3), 247-268.

56. Saddichha, S., Al-Desouki, M., Lamia, A., Linden, I.A., & Krausz, M. (2014). Online interventions for depression and anxiety - a systematic review. *Health Psychol Behav Med*, 2(1), 841-881.

57. Hartung, J. & Knapp, G. (2001). On test fo the overall treatment effect in meta-analysis with normally distributed responses. *Stat med*, 20(12), 1771-1782.

58. *Ly, K.H., Asplund, K., & Andersson, G. (2014). Stress management fo middle managers via an acceptance and commitment-based smartphone application: a randomized controlled trial. *Internet interventions*, 1(3), 95-101.

59. *Grime, P.R. (2004). Computerized cognitive behavioural therapy at work: arandomized controlled trial in employees with recent stress-related absenteeism. *Occup Med (Lond)*, 54(5), 353-359.

60. *Bostock, S., Luik, A., & Espie, C.A. (2016). Sleep and productivity benefits of digital cognitive behavioural therapy for insomnia: a randomised controlled trial conducted in the workplace environment. *J Occup Environ Med*, 58(7), 683-689.

61. *Billings, D.W., Cook, R.F., Hendrickson, A., & Dove, D.C. (2008). A web-based approach to managing stress and mood disorders in the workforce. *J Occup Environ Med*, 50(8), 960-968.

62. *Cook, R.F., Billings, D.W., Hersch, R.K., Back, A.S., & Hendrickson, A. (2007). A field test of web-based workplace health promotion program to improve dietary practices, reduce stress, and increase physical activity: randomized controlled trial. *J Med Internet Res*, 9(2), 1-14.

63. *Bolier, L., Ketelaar, S.M., Nieuwenhijsen, K., Smeets, O., Gartner, F.R., & Sluiter, J.K. (2014). Workplace mental health promotion online to enhance well-being of nurses and allied health professionals: a cluster-randomized controlled trial. *Internet Interventions*, 1(4), 196-204.

64. *Cook, R.F., Hersch, R.K., Schlossberg, D., & Leaf, S.L. (2015). A web-based health promotion program for older workers: randomized controlled trial. *J Med Internet Res*, 17(3), e82.

65. *Imamura, K., Kawakami, N., Tsuno, K., Tsuchiya, M., Shimada, K., & Namba, K. (2016). Effects of web-based stress and depression among workers: a randomized controlled trial. *J Affect Disord*, 203, 30-37.

66. Lazarus, R.S. & Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer.

67. *Phillips, R., Schneider, J., Molosankwe, I., Leese, M., Foroushani, P.S., Grime, P., et al. (2014). Randomized controlled trial of computerized cognitive behavioural therapy for depressive symptoms: effectiveness and costs fo a workplace intervention. *Psychol Med*, 44(4), 741-752.

68. *Khadjesari, Z., Freemantle, N., Linke, S., Hunter, R., & Murray, E. (2014). Health on the web: randomised controlled trial of online screening and brief alcohol intervention delivered in a workplace setting. *PLoS One*, 9(11), e112553.

69. Berger, D. (2015). Double blinding requirement for validity claims in cognitive-behavioral intervention trials for major depressive disorder. Analysis of Hollon S, et al., Effect of cognitive therapy with antidepressant medications vs antidepressants alone on the rate. *F1000 Res*, 4, 639.

70. *Thiart, H., Lehr, D., Ebert, D.D., Berking, M., & Riper, H. (2015). Log in and breathe out: internet-based recovery training for sleepless employees with work-related strain-results of a randomized controlled trail. *Scand J Work Environ Health*, 41(2), 164-174.

71. *Heber, E., Lehr, D., Ebert, D.D., Berking, M., & Riper, H. (2016). Web-Based and mobile stress management interventions for employees: a randomized controlled trial. *J Med Internet Res*, 18(1), e21.

72. *Ebert, D.D., Heber, E., Berking, M., Riper, H., Cuijpers, P., Funk, B., et al. (2016). Self-guided internet-based and mobile based stress management for employees: results of a randomised controlled trial. *Occup Environ Med*, 73(5), 315-323.

73. Von Hippel, P.T. (2015). The heterogeneity statistic I^2 can be biased in small meta-analyses. *BMC Medical Research Methodology*, 15, 35.

74. Helm, R. & Mark, A. (2012). Analysis and evaluation of moderator effects in regression models: state of art, alternatives and empirical example. *Review of Managerial Science*, 6(4), 307-332.

75. Hofer, P.D., Waadt, M., Aschwanden, R., Milidou, M., Acker, J., Meyer, A.H., et al. (2018). Self-help for stress and burnout without therapist contact: an online randomised controlled trial. *Work&Stress*, 32(2), 189-208.

76. *Boß, L., Lehr, D., Schaub, M.P., Castro, R.P., Riper, H., Berking, M., et al. (2018). Efficacy of a web-based intervention with and without guidance for employees with risky drinking: results of a three-arm randomized controlled trial. *Addiction*, 113(4), 635-646.

77. Riper, H., Hoogendoorn, A., Cuijpers, P., Karyotaki, E., Boumparis, N., Mira, A., et al. (2018). Effectiveness and treatment moderators of internet interventions for adult problem drinking: an individual patient data meta-analysis of 19 randomised controlled trials. *PLoS Med*, 15(12).

78. *Ebert, D.D., Lehr, D., Boss, L., Riper, H., Cuijpers, P., Andersson, G., et al. (2014). Efficacy of an internet-based problem-solving training for teachers: results of a randomized controlled trial. *Scand J Work Environ Health*, 40(6), 582-596.

79. *Ebert, D.D., Lehr, D., Heber, E., Riper, H., Cuijpers, P., & Berking, M. (2016). Internet- and mobile-based stress management for employees with adherence-focused guidance: efficacy and mechanism of change. *Scand J Work Environ Health*, 42(5), 382-394.

80. Button, K.S. & Munafò, M.R. (2015). Addressing risk of bias in trials of cognitive behavioral therapy. *Shanghai Arch Psychiatry*, 27(3), 144-148.

81. *Abbott, J.A., Klein, B., Hamilton, C., & Rosenthal, A. (2009). The impact of online resilience training for sales managers on well-being and work performance. *E-J Appl Psychol*, 5(1), 89-95.

82. *Aikens, K.A., Astin, J., Pelletier, K.R., Levanovich, K., Baase, C.M., Park, Y.Y., et al. (2014). Mindfulness goes to work: impact of an online workplace intervention. *J Occup Environ Med*, 56(7), 721-731.

83. *Jonas, B., Leuschner, F., & Tossmann, P. (2017). Efficacy of an internet-based intervention for burnout: a randomized controlled trial in the German working population. *Anxiety, stress, and coping*, 30(2), 133-144.

84. *Allexandre, D., Bernstein, A.M., Walker, E., Hunter, J., Roizen, M.F., & Morledge, T.J. (2016). A web-based mindfulness stress management program in a corporate call center: a randomized clinical trial to evaluate the edded benefit of onsite group support. *J Occup Environ Med*, 58(264), 254-264.

85. *Ketelaar, S.M., Nieuwenhuijsen, K., Gartner, F.R., Bolier, L., Smeets, O., & Sluiter, J.K. (2013). Effect of an E-mental health approach to workers' health surveillance versus control group on work funtioning of hospital employees: a cluster-RCT. *PLoS One*, 8(9), e72546.

86. *Lappalainen, P., Kaipainen, K., Lappalainen, R., Hoffren, H., Myllymaki, T., Kinnunen, M.L., et al. (2013). Feasibility of a personal health technology-based psychological intervention for men with stress and mood problems: randomized controlled pilot trial. *JMIR Res Protoc*, 2(1), e1.

87. *Mori, M., Tajima, M., Kimura, R., Sasaki, N., Somemura, H., Ito, Y., et al. (2014). A web-based training program using cognitive behavioral therapy to alleviate psychological distress among employees: randomized controlled pilot trial. *JMIR Res Protoc*, 3(4), e70.

88. *Myers, N.D., Prilleltensky, I., Prilleltensky, O., McMahon, A., Dietz, S., & Rubenstein, C.L. (2017). Efficacy of the fun for wellness online intervention to promote multidimensional well-being: a randomized controlled trial. *Prev Sci*, 8, 984-994.

89. *Neumeier, L.M., Brook, L., Dirchburn, G., & Sckopke, P. (2017). Delivering your daily dose of well-being to the workplace: a randomized controlled trial of an online well-being programme for employees. *J. Work Organ. Psychol*, 26(4), 555-573.

90. *Persson Asplund, R., Dagoo, J., Fjellstrom, I., Niemi, L., Hansson, K., Zeraati, F., et al. (2018). Internet-based stress management for distressed managers: results from a randomised controlled trial. *Occup Environ Med*, 75(2), 105-113.

91. *Querstret, D., Cropley, M., & Fife-Schaw, C. (2017). Internet-based instructor-led mindfulness for work-related rumination, fatigue, and sleep: assessing facets of mindulness as mechanisms for change. A randomized waitlist control trial. *J Occup Health Psychol*, 22(2), 153-169.

92. *Van Drongelen, A., Boot, C.R., Hlobil, H., Twisk, J.W., Smid, T., & Beek, A.J. (2014). Evaluation of an mHealth intervention aiming to improve health-related behavior and sleep and reduce fatigue among airline pilots. *Scand J Work Environ Health*, 40(6), 557-568.

93. *Rexroth, M., Michel, A., & Bosch, C. (2017). Promoting well-being by teaching employees how to segment their life domains: effects of an online-based mindfulness intervention. *Z Arb Organ*, 61(4), 197-212.

94. *Ruwaard, J., Lange, A., Bouwman, M., Broeksteeg, J., & Schrieken, B. (2007). E-mailed standardized cognitive behavioural treatment of work-related stress: a randomized controlled trial. *Cogn Behav Ther*, 36(3), 179-192.

95. *Shirotsuki, K., Nonaka, Y., Abe, K., Adachi, S.I., Adachi, S., Kuboki, T., et al. (2017). The effect for Japanese workers of a self-help computerized cognitive behaviour therapy program with a supplement soft drink. *BioPsychoSocial Medicine*, 11, 23.

96. *Taylor, D.J., Peterson, A.L., Pruiksma, K.E., Young McCaughan, S., Nicholson, K., Mintz, J., et al. (2017). Internet and in-person cognitive behavioral therapy for insomnia in military personnel: a randomized clinical trial. *Sleep*, 40(6), 1.

97. *Feicht, T., Wittmann, M., Jose, G., Mock, A., von Hirschhausen, E., & Esch, T. (2013). Evaluation of a seven-week web-based happiness training to improve psychological well-being, reduce stress, and enhance mindfulness and flourishing: a randomized controlled occupational health study. *Evid Based Complement Alternat Med*, 676953.

98. *Geraedts, A.S., Kleiboer, A.M., Wiezer Noortje, M., Mechelen, W., & Cuijpers, P. (2014). Short-term effects of a web-based guided self-help intervention for employees with depressive symptoms: randomized controlled trial. *J Med Internet Res*, 16(5), e51.

99. *Suzuki, E., Tsuchiya, M., Hirokawa, K., Taniguchi, T., Mitsuhashi, T., & Kawakami, N. (2008). Evaluation of an internet-based self-help program for better quality of sleep among Japanese workers: a randomized controlled trial. *J Occup Health*, 50(5), 387.

100. *Umanodan, R., Shimazu, A., Minami, M., & Kawakami, N. (2014). Effects of computer-based stress management training on psychological well-being and work performance in japanese employees: a cluster randomized controlled trial. *Ind Health*, 52(6), 480-491.

101. *Hirsch, A., Luellen, U.J., Holder, J.M., Steinberg, G., Dubiel, T., Blazejowskyj, A., et al. (2017). Managing depressive symptoms in the workplace using a web-based self-care tool: a pilot randomized controlled trial. *JMIR Res Protoc*, 6(4), e51.

102. *Imamura, K., Kawakami, N., Furukawa, T.A., Matsuyama, Y., Shimazu, A., Umanodan, R., et al. (2014). Effects of an internet-based cognitive behavioral therapy (iCBT) program in

manga format on improving subthreshold depressive symptoms among healthy workers: a randomized controlled trial. *PLoS One*, 9(5), e97167.

103. *Yuan, Q. (1983). *Evaluating the effectiveness of a psychological capital development program on mental health, engagement and work performance*. ProQuest Dissertations & Theses A&I.

104. Cohen. S., Kamarck, T., & Mermelstein, R. (1983). A global measure of perceived stress. *J health Soc Hehav*, 24(4), 385-396.

105. Maslach, C. & Jackson, S.E. (1986). *Maslach burnout inventory manual*. Palo Alto, CA: Consulting Psychologists Press.

106. Brown, K.Q. & Ryan, R.M. (2003). The benefits of being present: Mindfulness and its role in psychological well-being. *J Pers Soc Psychol*, 84, 822-848.

107. Hays, R.D., Sherbourne, C.D., & Mazel, R.M. (1993). The RAND 36-Item Health Survey 1.0. *Health Econ*, 2(3), 217-227.

108. Radloff, L.S. (1977). The CES-D scale: A self-report depression scale for research in the general population. *Appl Psychol Meas*, 1(3), 385-401.

109. Beck, A.T., Epstein, N., Brown, G., & Steer, R.A. (1988). An inventory for measuring clinical anxiety: Psychometric properties. *J Consult Clin Psychol*, 56, 593-897.

110. McCorkle, R., Cooley, M., & Shea, J. (1998). *A user's manual for the symptom distress scale*. Philadelphia: University of Pennsylvania, National Institute of Nursing Research.

111. Lovibond, S.H. & Lovibond, P.F. (1995). *Manual for the Depression Anxiety Stress Scales*. (2nd ed.). Sydney: Psychology Foundation.

112. Bastien, C.H., Vallières, A., & Morin, C.M. (2001). Validation of the Insomnia Severity Index as an outcome measure for insomnia research. *Sleep Med*, (4), 297-203.

113. Beck, A.T., Steer, R.A., Ball, R., & Ranieri, W. (1996). Comparison of Beck Depression Inventories-IA and -II in psychiatric outpatients. *J Pers Assess*, 67, 588-597.

114. Wolpe, J. (1969). *The practice of behavior therapy*. New York: Pergamon Press.

115. Gärtner, F.R., Ketelaar, S.M., Smeets, O., Bolier, L., Fischer, E., van Dijk, F.J., et al. (2011). The Mental Vitality @ Work study: design of a randomized controlled trial on the effect of a workers' health surveillance mental module for nurses and allied health professionals. *BMC Public Health*, 11, 290.

116. Terluin, B., Van Rhenen, W., Schaufeli, W.B., & De Haan, M. (2004). The Four-Dimensional Symptom Questionnaire (4DSQ): measuring distress and other mental health problems in a working population. *Work and Stress*, 18(3), 187-207.

117. Golderberg, D. & Williams, P. (1988). *A user's guide to the General Health Questionnaire*. Windsor: NFER-Nelson.

118. Kessler, R.C., Andrews, G., Colpe, L.J., Hiripi, E., Mroczek, D.K., Normand, S.L. Zaslavsky, A.M., et al. (2002). Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychol Med*, 32(6), 959-976.

119. Montgomery, S.A. & Asberg, M. (1979). A new depression scale designed to be sensitive to change. *Br. J. Psychiatry*, 134(4), 382-389.

120. Buysse, D.J., Reynolds, C.F., Monk, T.H., Berman, S.R., & Kupfer, D.J. (1989). The Pittsburgh Sleep Quality Index: a new instrument for psychiatric practice and research. *Psychiatry Res*, 28(2), 193-213.

121. Osipow, S.H. & Spokane, A.R. (1983). *A manual of occupational stress, strain, and coping*. Columbus: Marathon Consulting Press.

122. Spielberger, C.D., Gorssuch, R.L., Lushene, P.R., Vagg, P.R., & Jacobs, G.A. (1983). *Manual for the State-Trait Anxiety Inventory*. Palo Alto, CA: Consulting Psychologists Press.

123. Baer, R.A., Smith, G.T., Hopkins, J., Krietmeyer, J., & Toney, L. (2006). Using self-report assessment methods to explore facets of mindfulness. *Assessment*, 13(1), 27-45.

124. Shimomitsu, T., Yokoyama, K., Ono, Y., Maruta, T., & Tanigawa, T. (1998). Development of a novel brief job stress questionnaire. *Report of research grant for the prevention of work related diseases from Labour*, 107-15.

125. Nishikido, N., Kageyama, T., Kobayashi, T., & Haratani, T. (2000). Kani-shitsumonshi niyoru syokugyousei stress no hyoka (Measurements of job stress by a short questionnaire). *Occup Mental Health*, 8, 73-82.

126. Levenstein, S., Prantera, C., Varvo, V., Scribano, M.L., Berto, E., Luzi, C., et al. (1993). Development of the Perceived Stress Questionnaire: a new tool for psychosomatic research. *J Psychosom Res*, 37(1), 19-32.

127. Spitzer, R., Kroenke, K., & Williams, J. (1999). Validation and utility of a self-report Version of PRIME-MD: the PHQ Primary Care Study. *JAMA*, 282(18), 1737-1744.

128. Geraedts, A., Kleiboer, A.M., Twisk, J., Wiezer Noortje, M., Mechelen, W., & Cuijpers, P. (2014). Long-term results of a web-based guided self-help intervention for employees with depressive symptoms: randomized controlled trial. *J Med Internet Res*, 16(7), 14-28.

129. Mundt, J.C., Marks, I.M., Shear, M.K., & Greist, J.H. (2002). The Work and Social Adjustment Scale: a simple measure of impairment in functioning. *Br. J. Psychiatry*, 180, 46-464.

130. Evans, C., Connell, J., Barkham, M., Margison, F., McGrath, G., Mellor-Clark, J., et al. (2002). Towards a standardised brief outcome measure: Psychometric properties and utility of the CORE-OM. *Br. J. Psychiatry*, 180, 51-60.

131. Spitzer, R.L., Kroenke, K., Williams, J.B.W., & Löwe, B. (2006). A brief measure for assessing generalized anxiety disorder: the GAD-7. *Arch Intern med*, 166, 1092-1097.

132. McNair, D., Lorr, A., & Droppleman, L. (1971). *Edits manual: Profile of mood states*. San Diego: Educational and Industrial Testing Services.

133. Espie, C.A., Kyle, S.D., Hames, P., et al. (2014). The Sleep Condition Indicator: A clinical screening tool to evaluate insomnia disorder. *BMJ Open*, 18;4(3), e004183.

134. WHO. (2018). *eHealth at WHO*.

135. Keyes, C.L.M. (2002). The mental health continuum: From languishing to flourishing in life. *J Health Soc Behav*, 43, 207-222.

136. Derogatis, L.R. & Melisaratos, N. (1983). The Brief Symptom Inventory: An introductory report. *Psychol Med*, 13(3), 595-605.

137. Flanagan, J.C. (1978). A research approach to improving our quality of life. *Am Psychol*, 33(2), 138-147.

138. Bech, P., Gudex, C., & Staehr Johansen, K. (1996). The WHO (Ten) well-being index: validation in diabetes. *Psychother Psychosom*, 65, 183-190.

139. Stefano, G.B., Benson, H., Fricchione, G.L., & Esch, T. (2005). *The stress response: Always good and when it is bad*. New York: Medical Science International.

140. Walach, H., Buchheld, N., Buttenmuller, V., Kleinknecht, N., & Schmidt, S. (2006). Measuring mindfulness - The Freiburg Mindfulness Inventory (FMI). *Personality and individual differences*, 40, 1543-1555.

141. Prilleltensky, I., Dietz, S., Prillelensky, O., Myers, N.D., Rubenstein, C.L., Jin, Y., et al. (2015). Assessing multidimensional well-being: Development and validation of the I COPPE scale. *Am J Community Psychol*, 43(2), 199-226.

142. Diener, E. & Ryan, K. (2009). Subjective well-being: a general overview. *S Afr J Psychol*, 39(4), 391-406.

143. Tennant, R., Hiller, L., Fishwick, R., Platt, S., Joseph, S., Weich, S., et al. (2007). The Warwick-Edinburgh mental well-being scale (WEMWBS) development and UK validation. *Health Qual Life Outcomes*, 5(1), 63.

144. Feldman, G., Hayes, A., Kumar, S., Greeson, J., Laurenceau, J.P. (2007). Mindfulness and emotion regulation: the development and initial validaiton of the Cognitive and Affective Mindfulness ScaleRevised (CAMS-R). *J Psychopathol Behav Assess*, 29(3), 177-190.

145. Demerouti, E. & Nachreiner, F. (1998). Zur Spezifität von Burnout für Dienstleistungsberufe: Fakt oder Artefakt. *Zeitschrift für Arbeitswissenschaft*, 52(2), 82-89.

146. Orioli, E.M., Jaffe, D..T, S& cott, C.D. (1991). *Stressmap: Personal diary edition. The ultimate stress management, self-assessment, and coping guide*. New York: Newmarket Press.

147. Zigmond, A.S. & Snaith, R.P. (1983). The Hospital Anxiety and Depression Scale. *Acta Psychiatr Scand*, 67(6), 361-370.

Appendix 2. A Full electronic search strategies

Search strategy: MEDLINE

(((((((stress [Title/Abstract] OR distress [Title/Abstract] OR mental [Title/Abstract] OR depress* [Title/Abstract] OR anxiety [Title/Abstract] OR sleep [Title/Abstract] or substance [Title/Abstract] OR fatigue [Title/Abstract] OR alcohol* [Title/Abstract] or workaholism [Title/Abstract] or fatigue [Title/Abstract] or mental[Title/Abstract] OR burnout[Title/Abstract] OR well-being[Title/Abstract] OR well-being[Title/Abstract] OR drinking[Title/Abstract] OR absenteeism[Title/Abstract] OR presenteeism[Title/Abstract] OR "Stress, Psychological"[MeSH]) OR "Fatigue"[MeSH] or "Burnout, Professional"[MeSH] OR "Depression"[MeSH] OR "Depressive Disorder"[MeSH] OR "Sleep Initiation and Maintenance Disorders"[MeSH] OR "Alcohol-Related Disorders"[MeSH] OR "Absenteeism"[MeSH] OR "Presenteeism"[MeSH] OR "Mental Health"[MeSH] OR "Anxiety"[MeSH] or "Substance-Related Disorders"[MeSH])

AND ((internet[Title/Abstract] OR "Internet"[MeSH] OR "Telemedicine"[MeSH] OR “Therapy, Computer-Assisted” [MeSH] or web[Title/Abstract] OR online[Title/Abstract] OR computerized[Title/Abstract] OR computer[Title/Abstract] OR e-health[Title/Abstract] OR e-health[Title/Abstract] OR digital[Title/Abstract] OR tele-health[Title/Abstract] OR mhealth[Title/Abstract] OR program[Title/Abstract] OR application[Title/Abstract] or “e-mental health”[Title/Abstract])))

AND ((occupation*[Title/Abstract] OR worker* [Title/Abstract] or working [Title/Abstract] OR workplace [Title/Abstract] or “at work” [Title/Abstract] or [Title/Abstract] or workforce [Title/Abstract] or work-related [Title/Abstract] OR employee*[Title/Abstract] or "Occupational Health"[MeSH] or workplace [MeSH]))

AND ((randomized control trial [MeSH Terms] or randomized controlled trial [Publication Type]) or (random*[Title/Abstract] AND control*[Title/Abstract])))))

Search strategy: PsycINFO

(stress/ or exp occupational stress/ or exp psychological stress/ or exp social stress/ or major depression/ or well being/ or mental health/ or insomnia/ or sleep disorders/ or alcoholism/ or addiction/ or alcohol abuse/ or fatigue/ or anxiety/ or anxiety disorders/ or employee absenteeism/ or distress/ or workaholism/ or work related illnesses/ or "substance abuse and addiction measures"/ or (stress or distress or mental or depress* or anxiety or sleep or insomnia or fatigue or workaholism or burnout or well-being or well-being or alcohol* or substance or drinking or absenteeism or presenteeism).ab. or (stress or distress or mental or depress* or anxiety or sleep or insomnia or fatigue or workaholism or burnout or well-being or well-being or alcohol* or substance or drinking or absenteeism or presenteeism).ti.)

and (internet/ or telemedicine/ or computer assisted therapy/ or online therapy/ or computer mediated communication/ or (Internet or web or online or computerized or computer or e-health or e-health or digital or tele-health or mhealth or program or application or e-mental health).ab. or (Internet or web or online or computerized or computer or e-health or e-health or digital or tele-health or mhealth or program or application or e-mental health).ti.)

and (employee assistance programs/ or workplace intervention/ or occupational health/ or (occupation* or at work or working or worker* or work-related or employee* or worksite or workplace or workforce).ab. or (occupation* or at work or working or worker* or work-related or employee* or worksite or workplace or workforce).ti.)

and ((random* and control*).ab. or (random* and control*).ti. or Clinical trial/)

Search strategy: Cochrane Central Register of Controlled Trials (CENTRAL)

#1 randomized controlled trial:pt 438361

#2 MeSH descriptor: [Randomized Controlled Trials as Topic] explode all trees 22823

#3 random*:ti,ab and control*:ti,ab 336646

#4 #1 or #2 or #3 603600

#5 occupation*:ti,ab 4471

#6 employee*:ti,ab 1756

#7 working:ti,ab 9529

#8 work-related:ti,ab 697

#9 workplace:ti,ab 1399

#10 workforce:ti,ab 285

#11 "at work":ti,ab 697

#12 worksite:ti,ab 587

#13 worker*:ti,ab 5615

#14 MeSH descriptor: [Workplace] explode all trees 776

#15 MeSH descriptor: [Occupational Health] explode all trees 637

#16 #5 or #6 or #7 or #8 or #9 or #10 or #11 or #12 or #13 or #14 or #15 20812

#17 web:ti,ab or online:ti,ab or computer:ti,ab or computerized:ti,ab or e-health:ti,ab or e-health:ti,ab or digital:ti,ab or tele-health:ti,ab or mhealth:ti,ab or program:ti,ab or application:ti,ab or "e-mental health":ti,ab or internet:ti,ab 100554

#18 MeSH descriptor: [Internet] this term only 3145

#19 MeSH descriptor: [Telemedicine] explode all trees 2064

#20 MeSH descriptor: [Therapy, Computer-Assisted] explode all trees 2987

#21 #17 or #18 or #19 or #20 103369

#22 MeSH descriptor: [Stress, Psychological] explode all trees 4960

#23 MeSH descriptor: [Fatigue] explode all trees 2486

#24 MeSH descriptor: [Burnout, Professional] explode all trees 178

#25 MeSH descriptor: [Depression] explode all trees 7487

#26 MeSH descriptor: [Depressive Disorder] explode all trees 9121

#27 MeSH descriptor: [Sleep Initiation and Maintenance Disorders] explode all trees 1596

#28 MeSH descriptor: [Alcohol-Related Disorders] explode all trees 4197

#29 MeSH descriptor: [Absenteeism] explode all trees 528

#30 MeSH descriptor: [Presenteeism] explode all trees 12

#31 MeSH descriptor: [Mental Health] explode all trees 1140

#32 MeSH descriptor: [Anxiety] explode all trees 6741

#33 MeSH descriptor: [Substance-Related Disorders] explode all trees 11525

#34 stress:ti,ab or distress:ti,ab or mental:ti,ab or depress*:ti,ab or anxiety:ti,ab or sleep:ti,ab or substance:ti,ab or fatigue:ti,ab or alcohol*:ti,ab or workaholism:ti,ab or burnout:ti,ab or well-being:ti,ab or well-being:ti,ab or drinking:ti,ab or absenteeism:ti,ab or presenteeism:ti,ab or fatigue:ti,ab or mental:ti,ab 150157

#35 #22 or #23 or #24 or #25 or #26 or #27 or #28 or #29 or #30 or #31 or #32 or #33 or #34 158298

#36 #4 and #16 and #21 and #35 1027

Search strategy: CINAHL

((MH “Internet”) or (MH "Telemedicine+") or (MH "Tele-health+") or (ti internet or ab internet) or (ti web or ab web) or (ti computerized or ab computerized) or (ti computer or ab computer) or (ti e-health or ab e-health) or (ti e-health or ab e-health) or (ti digital or ab digital) or (ti tele-health or ab tele-health) or (ti mhealth or ab mhealth) or (ti program or ab program) or (ti application or ab application) or (ti “e-mental health”or ab “e-mental health”))

and ((ti occupation* or ab occupation*) or (ti at work or ab at work) or (ti working or ab working) or (ti worker* or ab worker*) or (ti work-related or ab work-related) or (ti worksite or ab worksite) or (ti workplace or ab workplace) or

(ti workforce or ab workforce) or (ti work-related or ab work-related) or (ti employee* or ab employee*) or (MH "Workforce") or (MH "Occupational Health Services+"))

and

((MH "Stress+") or (ti stress or ab stress) or (ti mental or ab mental) or (MH "Mental Health") or (ti depress* or ab depress) or (MH "Depression") or (MH "Anxiety") or (MH "Anxiety Disorders+") or (ti anxiety or ab anxiety) or (MH “Fatigue”) or (ti fatigue or ab fatigue) or (ti alcohol* or ab alcohol*) or (MH "Alcoholism") or (ti workaholism or ab workaholism) or (MH "Burnout, Professional") or (ti burnout or ab burnout) or (ti well-being or ab well-being) or (ti well-being or ab well-being) or (ti drinking or ab drinking) or (ti absenteeism or ab absenteeism) or (MH "Absenteeism") or (MH "Presenteeism") or (ti sleep or ab sleep) or (ti insomnia or ab insomnia) or (MH "Insomnia") or (ti substance or ab substance) or (MH "Substance Use Disorders+"))

and

((TI random*AND TI control*) or (AB random* AND AB control*) or (MM "Randomized Controlled Trials") or PT clinical trial)

Search strategy: US National Institutes of Health Ongoing Trials Register ClinicalTrials.gov www.clinicaltrials.gov

Condition/disease: Stress OR distress OR depression OR anxiety OR sleep OR fatigue OR substance OR alcohol OR workaholism OR burnout OR well-being OR well-being OR insomnia OR sleep OR absenteeism OR presenteeism OR burnout OR "mental health"

Other terms: employee OR worker OR workplace OR occupation OR working OR worksite OR workforce OR work-related OR "at work"

employee OR occupation OR working OR worksite OR work-related OR "at work"

Intervention/treatment:

Internet OR web OR online OR computer OR e-health OR e-health OR digital OR tele-health OR mhealth OR application OR “e-mental health”

Filters: Completed

Interventional (or Clinical Trial)

Search strategy: WHO International Clinical Trials Registry Platform (ICTRP) http://apps.who.int/trialsearch/

Title: employee* OR work* OR occupation*

Condition: Stress OR distress OR depression OR anxiety OR sleep OR fatigue OR substance OR alcohol OR workaholism OR burnout OR well-being OR insomnia OR well-being OR absenteeism OR presenteeism OR burnout

Intervention: Internet OR web* OR computer* OR online OR e-health OR e-health OR mhealth OR tele-health OR application OR program OR digital.

Appendix 2. B Characteristics of the studies

Table 1: Characteristics of the studies

Author Year-Country	Study design/setting	Participants	Recruitment	Intervention (IG)/Control condition (CC)	Personal guidance	Outcomes	Key findings, effects compared with the control group	Attrition rate
Stress								
Allexandre et al. 2016 (84) USA	4 arms[4] Duration: 8 weeks Follow up: 16 weeks, 1 year only for IG Study setting: employees in a corporate call center	Randomization of 161[5] Male rate: 16.8% Mean age: 40.0 Education: -	workplace	I1: Web-based mindfulness stress management program I2: I1 plus group support I3: I1 plus group and expert clinical support CC: Waitlist	Yes, in IG3	PSS-10 (104) § MBI-EE (105) MAAS[6] (106) SF-36[7] (107)	The IG demonstrated significant moderate effects on perceived stress and emotional well-being and small effects on burnout and mindfulness at postassessment and at follow up. Group support improved the outcomes. No significant difference was observed when providing expert onsite support in addition to group support alone.	38.0% T1 52.0% T2
Billings et al. 2008 (61) USA # $$	2 arms Duration: access for 3 months Study setting: employees from a major technology company in the mid-Atlantic region	Randomization of 309 Male rate: 29.4% Mean age 30-39: 51.1% Education: 43.4% college degree	workplace	I: Web-based multimedia stress and mood management program with CBT elements CC: Waitlist	No	CES-D (108) BAI[8] (109) SDS[9] (110)	The IG showed significant improvements with small effects on stress and binge drinking.	21.0%

[4] Only 2 arms included in the meta-analysis intervention group (IG) versus the control group (CG).
[5] N=91 in the 2 arms considered.
[6] Mindfulness Attention Awareness Scale (MAAS).
[7] Short Form Health Survey (SF-36).
[8] Beck Anxiety Inventory (BAI).
[9] Symptom Distress Scale (SDS).

Carolan et al. 2017 (27) UK °°	3 arms Duration: 8 weeks Follow up: 16 weeks Study setting: employees from six organizations (two local authorities, two universities, one third-sector organization, and a telecommunications organization) with an elevated level of stress, score ≥20 on the PSS-10	Randomization of 84 Male rate: 15% Mean age: 41 Education: 39% master's, doctorate or equivalent	workplace	I1: Guided CBT-based stress management intervention with a discussion group I2: Guided CBT-based stress management intervention without a discussion group[10] CC: Waitlist	Yes, e-coach and discussion group	DASS-21 (111)	Small to medium effect size differences were found at posttreatment in favor of the active conditions compared with the control on the depression, anxiety and stress DASS subscales and the enthusiasm and comfort IWP subscales. This result was largely maintained at follow up.	26.19 % T1
Cook et al. 2007 (62) USA # °° @[11]	2 arms Duration: access for 3 months Follow up: - Study setting: employees of a human resources company	Randomization of 419 Male rate: 27.4% Mean age: 42.0 Education: 60.9% university-level education	workplace	I: Web-based health promotion program rooted in accepted models of health behavior change, designed to improve dietary practices, reduce stress, and increase physical activity CC: Print materials on the same topics	No	PSS-5 (104) SDS (110)	The web-based program was more effective than print materials in the areas of diet and nutrition but was not more effective in stress reduction.	14.5% T1
Cook et al. 2015 (64) USA # °° $$	2 arms Duration: access for 3 months Follow up: - Study setting: employees aged 50 to 68 from multiple US offices of a	Randomization of 278 Male rate: 67.3% Mean age: 55.4 Education: 54.0% university education	workplace	I: Web-based health promotion program containing information on the major health promotion topics of healthy aging, diet, physical activity, stress management, and	No	SD[12] (146)	The intervention showed significant contributions to short-term dietary and exercise practices, but no significant differences between the two groups in measures of	12.6% T1

[10] The arm without a discussion group compared to the waitlist was used for the meta-analysis because of better comparability to other interventions.

[11] Not included in the meta-analysis because of an active control condition.

[12] *Symptoms* of *Distress* (147)

	large global information technology company			tobacco use based on social cognitive theory CC: Waitlist			stress were found.	
Ebert et al. 2016a (79) Germany ~	2 arms Duration: 7 weeks Follow up: 6 months Study setting: general working population with PSS-10≥22	Randomization of 264 Male rate: 14.1% Age: 42.9 Education: 71.9% high level	community	I: Internet-based adherence-focused guided stress management intervention CC: Waitlist	Yes, participants received adherence-focused guidance from an e-coach	PSS-10 (104) § ISI (113) CES-D (108) HADS-A (113) MBI-EE (105)	The IG participants showed a significantly higher reduction in perceived stress at postassessment (g=0.79) and at the 6-month follow up (g=0.84) compared with the controls. Significant moderate to large short- and long-term effect sizes were also found for other mental health outcomes.	9.1% T1 17.0% T2
Ebert et al. 2016b (73) Germany ~	2 arms Duration: 7 weeks Follow up: 6 months Study setting: general working population with PSS-10≥22	Randomization of 264 Male rate: 28.0% Mean age: 42.0 Education: 67.0% high level	community	I: Internet- and mobile-based intervention based on the Lazarus and Folkman transactional model of stress and its distinction between problem-focused and emotion-focused coping CC: Waitlist with treatment as usual (TAU) access	No	PSS-10 (104) § ISI (112) CES-D (108) HADS-A (113) MBI-EE (105)	Individuals in the IG experienced significantly higher reductions in perceived stress at postassessment (g=0.95) and at the 6-month follow up (g=0.64) compared with the controls. Significant moderate short- and long-term effects were also found for other mental health outcomes.	5.7% T1 9.8% T2
Eisen et al 2008 (39) USA @[13]	3 arms Duration: 2 weeks Follow up: 1 month Study setting: employees from three	Randomization of 288 Male rate: 64.7% Mean age: 44.4 Education: 74.1% college degree	workplace	I1: Computerized CBT-based stress management intervention with multiple two-minute mini-relaxations	No	SUDS[14] (114)§	Individuals in both intervention groups experienced significant reductions in stress immediately following the 2-minute mini-relaxations, but	52.0% T1 - T2

[13] Not included in the meta-analysis because of the lack of data.
[14] Subjective Units of Distress Scale (SUDS).

	manufacturing sites within a single corporation			I2: CBT-based stress management intervention with multiple two-minute mini-relaxations via instructor CC: Waitlist			there were no significant improvements at the end of the intervention or at the follow up.	
Heber et al. 2016 (72) Germany ~	2 arms (intervention, waitlist with access TAU) Duration: 7 weeks Follow up: 6 months, 12 months for IG Study setting: general working population with PSS-10≥22	Randomization of 264 Male rate: 26.9% Mean age: 43.3 Education: 76.9% highly educated	community	I: Internet- and mobile-based intervention based on the Lazarus and Folkman transactional model of stress and its distinction between problem-focused and emotion-focused coping CC: Waitlist with TAU access	Yes, participants received written feedback on every completed session from an e-coach	PSS-10 (104) § ISI (113) CES-D (108) HADS-A (113) MBI-EE (105)	Individuals in the IG experienced significantly higher reductions in perceived stress at postassessment (g=0.83) and at the 6-month follow up (g=1.01) compared with the controls. The within-group effect was g=1.83 after 1 year. Significant large to moderate short- and long-term effects were also found for other mental health outcomes.	5.7% T1 10.6% T2 30.3% T3
Ketelaar et al. 2013 (85) Netherlands	2 arms Duration: 3 months Follow up: 6 months Study setting: nurses and allied health professionals employed at an academic hospital	Randomization of 1140 Male rate: 20.2% Mean age: 40.0 Education: -	workplace	I: Personalized feedback on mental health and a matched offer of an online self-help mental health intervention CC: Waitlist	No	NWFQ[15] (115) § 4DSQ[16] (116)	The study was faced with substantial drop-outs and could not demonstrate the effectiveness of the intervention on any outcomes compared to the control group.	64.6% T1 81.7% T2
Ly et al. 2014 (58) Sweden	2 arms Duration: 6 weeks Follow up: - Study setting: middle managers at medium- and large-	Randomization of 74 Male rate: 42% Mean age: 41.5	workplace	I: Smartphone stress intervention based on acceptance and commitment therapy (ACT) CC: Waitlist	Yes, the therapist sent encouraging	GHQ-12[17] (117)§ PSS-14 (104)	The IG participants scored lower than the control group on the PSS-14 at 6 weeks with a small effect.	6.7% T1

[15] Nurses Work Functioning Questionnaire.
[16] Four-Dimensional Symptom Questionnaire (4DSQ).
[17] General Health Questionnaire (GHQ-12).

	sized companies (N>50 employees)	Education: 47.0% university education			personal messages every other day to the participants			
Mori et al. 2014 (87) Japan	2 arms Duration: 150 min class + 1 month Follow up: 6 months Study setting: employees at an information technology company in Tokyo, Japan	Randomization of 187 Male rate: 78.0% Mean age: 38.4 Education: -	workplace	I: 150-minute group class presented by a qualified CBT expert on CBT and 1 month of homework via a web-based CBT program CC: Waitlist	Yes	K6 (118)§	Although the IG exhibited lower K6 scores, the difference from the control group was not significant.	15.5% T1 17.2% T2
Persson et al. 2017 (90) Sweden @[18]~	2 arms Duration: 8 weeks Follow up: 6 months Study setting: distressed managers mainly employed in the healthcare, information technology, communications and education sectors	Randomization of 117 Male rate: 33.0% Mean age: 46.9 Education: 91% university-level education	community	I: Internet-based stress management intervention including cognitive behavioral stress management and positive management techniques CC: Attention control (AC) condition, weekly mail contact, homework assignment	Yes, participants received weekly guidance from a psychologist focusing on feedback and adherence	PSS-14[19] (104) § MADRS-S[20] (119) SMBQ[21] (120) ISI (112)	Participants in the IG reported significantly fewer symptoms of perceived stress, depression, insomnia, and burnout with moderate to large effects at postassessment. Significant medium to large effect sizes on the mental health outcomes were also found at the 6-month follow up.	20.5% T1 29.9% T2
Ruwaard et al. 2007 (94) Netherlands ~	2 arms Duration: 7 weeks Follow up: 3 years for IG Study setting: general working	Randomization of 239 Male rate: 40.0% Mean age: 44.0 Education: 84.0%	community	I: E-mail-based cognitive behavioral treatment including practical exercises CC: Waitlist	Yes, communication between clients and	Stress, § anxiety and depression subscales from the DASS-	The IG showed statistically significant moderate improvements in stress and small significant effects for other mental health outcomes	20.9% T1 64.4% T2

[18] Not included in the meta-analysis because of an active control condition.
[19] Perceived stress (PSS-14).
[20] Montgomery-Åsberg Depression Rating Scale (MADRS).
[21] Shirom-Melamed Burnout Questionnaire (*SMBQ).*

	population with PSS-10≥22	highly educated			therapists took place through regular e-mails	42[22] (111) MBI-EE (105)	at the end of treatment. At the 3-year follow up, the positive developments were maintained with large within-group effects for all outcomes.	
Smith 1987 (50) USA #	2 arms Duration: 5 weeks Follow up: - Study setting: adult male juvenile counselors from the Juvenile Services Administration, Baltimore City, Maryland	Randomization of 30 Male rate: 100% Age: 31-40 67.0% Education: 53.0% master's degree	workplace	I: Computerized self-help stress coping program based on cognitive learning theory CC: Waitlist	No	PStQ[23] (121) SA[24] (122)	The IG demonstrated statistically significant decreases in state anxiety with small effect.	-
Umanodan et al. 2014 (100) Japan	2 arms Duration: 7 weeks Follow up: 12 weeks Study setting: 12 work units from the research and development divisions and support staff in a manufacturing company	Randomization of 263 Male rate: 92.6% Mean age: 38.9 Education: -	workplace	I: Computerized CBT-based stress management program CC: Waitlist	No	BJSQ[25] (124) §	A small significant effect of the intervention was found only for "knowledge of stress management" at T1 but not for any other primary or secondary outcomes.	3.4% T1 5.7% T2
Wolever et al. 2012 (38) USA $$ @[26]	3 arms Duration: 12 weeks Follow up: - Study setting: employees of a national insurance company	Randomization of 239 Male rate: 23.4% Mean age: 42.9 Education: 72.4% college, gradu-	workplace	I1: Therapeutic yoga I2: Stress management program based on the practices of mindfulness meditation provided through an online virtual classroom	Yes, mediation teacher	PSS-10 (104)§ PSQI (120) CES-D (108)	Compared with the control group, the mind-body interventions yielded significantly greater improvements in perceived stress with a moderate effect	14.2% T1

[22] Depression, Anxiety and Stress Scales (DASS-42).
[23] Personal Strain Questionnaire (PStQ).
[24] State anxiety from the State-Trait Anxiety Inventory.
[25] Brief Job Stress Questionnaire (BJSQ).
[26] Not included in the meta-analysis because of the lack of data.

		ate, or professional degree		by a meditation teacher CC: List of resources available to all employees of the national insurance carrier			and in sleep quality with a small effect.	
Yamagishi et al. 2008 (36) Japan # @[27]	2 arms Duration: 3 weeks Follow up: 4 weeks Study setting: shift-work nurses from two urban hospitals	Randomization of 60 Male rate: - Mean age: - Education: -	workplace	I: Web-based career identity training CC: Waitlist	No	JSBQ[28] (125)-mental workload BJSQ (126)-anxiety, depression	The IG showed significant improvements in two career identity subscales, but there was no evidence of significant improvements in mental health or stress-related outcomes.	40.0% T1 56.7% T2
Depression								
Ebert et al. 2014 (78) Germany	2 arms Duration: 7 weeks Follow up: 6 and 12 months Study setting: employed teachers	Randomization of 150 Male rate: 16.7% Mean age: 47.1 Education: 100% university degree	community	I: Internet-based problem-solving training CC: Waitlist	No	CES-D[29] (108) § PSQ[30] (126)	IG participants displayed a significantly greater reduction in depressive symptoms and stress after the intervention with moderate and small effects at postassessment and follow up compared with the control group.	11.3% T1 19.0% T2 15.5% T3
Birney et al. 2016 (47) USA ~ °° $$ @[31]	2 arms Duration: 6 weeks Follow up: 10 weeks Study setting: general working population	Randomization of 300 Male rate: 23.0% Mean age: 40.7 Education: 90% col-	community	I: CBT-based depression self-management mobile app MoodHacker CC: E-mail with links to vetted online information	No	PHQ-9[32] (127) §	At the end of treatment, depression symptoms had significantly decreased with a small effect compared with the control	4.7% T1 5.0% T2

[27] Not included in the meta-analysis because the validity of the measures used was not reported.
[28] Job Stress Brief Questionnaire.
[29] Center for Epidemiologic Studies Depression Scale (CES-D).
[30] Perceived Stress Questionnaire (PSQ).
[31] Not included in the meta-analysis because of an active control condition.
[32] Patient Health Questionnaire (PHQ-9).

	with mild to moderate depression (PHQ-9>9)	lege, university or graduate school educated		about depression			group; at 10 weeks, the small treatment effect was no longer significant.	
Geraedts et al. 2014a/2014b (98) (128) ~	2 arms Duration: max 7 weeks Follow up: 6 and 12 months Study setting: Employees from 6 different companies with depressive symptoms >16 on the CES-D	Randomization of 231 Male rate: 37.7% Mean age: 43.4 Education: 63.3% highly educated	workplace	I: Problem-solving and cognitive therapy CC: Care as usual	No	CES-D (108) § HADS[33] (147) MBI-EE (105)	The IG had decreased anxiety with a small significant effect at posttreatment. There were no other significant differences between the groups in any other outcomes posttreatment or long-term.	26.4% T1 32.0% T2 46.0% T3
Grime et al. 2004 (59) UK ~ #	2 arms Duration: 8 weeks Follow up: 1, 3, and 6 months after treatment Study setting: public sector employees with 10 or more cumulative days of stress-related absenteeism in the last 6 months	Randomization of 48 Male rate: 42.0% Mean age: 39.0 Education: -	workplace	I: Computerized CBT program plus conventional care CC: Conventional care	No	HADS (113) MBI-EE[34] (105)	The IG had statistically significantly lower depression and negative attributional style scores at the end of treatment and 1 month later and lower anxiety scores 1 month posttreatment.	18.8% T1 29.1% T2 33.3% T3 31.3% T4
Hirsch et al. 2017 (101) USA °° @[35]	2 arms Duration: 26 weeks Study setting: employees of a mid-sized financial software firm	Randomization of 165 Male rate: 65.0% Mean age: 68.3% 41-60 years Education: -	workplace	I: Web- and mobile-based CBT and 12 informational e-mails CC: Informational e-mails about depression	No	DASS[36]-21 (111)§	myStrength users demonstrated significantly steeper reductions in depressive symptoms over time than the active control group with a small effect.	67.0% T1

[33] Hospital Anxiety and Depression Scale (HADS) (148).
[34] Maslach Burnout Inventory-Emotional Exhaustion (MBI-EE).
[35] Not included in the meta-analysis because of an active control condition.
[36] Depression Anxiety Stress Scales (DASS).

Imamura et al. 2014 (102) Japan	2 arms Duration: max 10 weeks Follow up: 3 and 6 months Study setting: employees at two companies developing information systems	Randomization of 762 Male rate: 83.8% Mean age: 37.6 Education: 89.9% college, university or graduate school educated	workplace	I: Web-based CBT program CC: E-mails with stress management tips	No, but voluntary homework with feedback from clinical psychologists	BDI-II[37] (113) § K6[38] (118)	The iCBT program showed small statistically significant effects on BDI-II at the 3- and 6-month follow ups.	20.5% T1 22.3% T2
Imamura et al. 2016 (65) Japan ~	2 arms Duration: access for 4 months Follow up: 1 and 4 months Study setting: currently employed workers in the high-risk group (visited mental health specialist in the past month), moderate risk K6≥5 and low-risk group K6≤4 distress scores	Randomization of 1236 Male rate: 70.0% Mean age: 39.4 Education: 47.7% university degree	community	I: Psychoeducational website "UTSMed" CC: Waitlist	No	BDI-II[39] (113) § K6 (118)	The intervention was effective at a significant level in reducing depression and stress with moderate effects only among participants in the high-risk subgroup.	11.8% T1 17.5% T2
Lappalainen et al. 2013 (86) Finland ~	2 arms Duration: - Follow up: 6 months Study setting: full-time employed males aged 25 to 45 years with exhaustion, stress symptoms, or sleeping problems	Randomization of 24 Male rate: 100% Mean age: 43.3 Education: -	community	I: CBT- and ACT-based program delivered via multiple channels, including group meetings, web portal, mobile phone applications, and personal monitoring devices CC: Waitlist	Yes, 3 psychologist-assisted group meeting	BDI-II (113)§	There were no significant changes in depressive scores between the groups after the treatment. A significant within-group effect in the IG was found at the follow up.	4.1% T1

[37] Beck Depression Inventory-II (BDI-II).
[38] Kessler Psychological Distress Scale (K6).

Phillips et al. 2014 (67) UK ~ @[40]	2 arms Duration: 5 weeks Follow up: 6 and 12 weeks Study setting: employees with PHQ-9≥10 at three companies in the transport, health and communication sectors	Randomization of 637 Male rate: 46.4% Mean age: 42.4 Education: -	workplace	I: Computerized CBT intervention CC: Weekly e-mails and five websites containing general information on mental health	Yes, weekly calls by clinical study officer, 10 min on average	WSAS (129)§ PHQ-9 (127) CORE10[41] (130) GAD[42] (131)	There was no evidence of a difference in the treatment effect of the intervention on any of the outcomes.	43.6% T1 63.7% T2
Shirotsuki et al. 2017 (95) Japan # °°	3 arms Duration: 6 weeks Follow up: - Study setting: office workers from beverage, alcoholic beverage, and food manufacturing/sales companies in Tokyo	Randomization of 87 Male rate: 68.0% Mean age: 37.2 Education:-	workplace	I1: CBT program I2: I1 with L-carnosine drink CC: Waitlist	No	POMS[43] (132) (Japanese version)	The intervention significantly changed the subjective experience of tension-anxiety with a moderate effect. The addition of a supplement drink enhanced the treatment effect only for fatigue.	17.2% T1
Insomnia								
Bostock et al. 2016 (60) USA ~	2 arms Duration: 8 weeks Follow up: 3 months Study setting: ‘‘Fortune 500’’ company, mainly office workers self-identified as having poor sleep	Randomization of 270 Male rate: 90.0% Mean age: 33.6 Education: -	workplace	I: Digital CBT with e-mail/SMS prompts and access to a moderated online community CC: Waitlist	No	SCI (133)[44] PHQ-2[45] (127) GAD-2 (131)[46]	The IG showed a significant large effect on sleep quality. The small improvements in anxiety and depression were not significant. The large within-group effect on sleep was maintained after 3 months.	20.5% T1 38.5% T2
Hasson et al. 2005 (49)	2 arms Duration: 6 months	Randomization of 303	workplace	I: Web-based tool for health promotion and	No	Sleep quality on	The IG improved signifi-	8.6% T1

[40] Not included in the meta-analysis because of an active control condition.
[41] *Clinical Outcomes* in Routine Evaluation.
[42] Generalized Anxiety Disorder (GAD) Assessment.
[43] Profile of Mood State (POMS).
[44] Sleep Condition Indicator (SCI).
[45] Patient Health Questionnaire (PHQ-2) (2 items).
[46] Generalized Anxiety Disorder questionnaire (GAD-2) (2-items).

Sweden #@[47]	Study setting: employees from four information technology and two media companies	Male rate: 61.7% Mean age: 74.5% >30 Education: 51.4% academic degree		stress management with real-time monitoring of stress status. In addition, participants in the IG were offered web-based cognitive exercises CC: Intervention without the possibility of web-based cognitive exercises		VAS[48] Biological markers	cantly compared with the control group with small effects on sleep quality, perceived ability to manage stress and other mental outcomes. Furthermore, the IG showed significant decreases in the hormone neuropeptide Y (NPY), which has been found to promote sleep.	
Querstret et al. 2017 (91) UK # $$	2 arms Duration: 4 weeks Follow up: 3 and 6 months Study setting: general working population with affective rumination score ≥15	Randomization of 127 Male rate: 19.5% Mean age: 40.6 Education: 68.6% university educated	community	I: Online mindfulness-based stress reduction and cognitive therapy CC: Waitlist	No	PSQI (120)[49] FFMQ-4 (123)[50]	The IG significantly improved sleep quality and mindfulness with large effects after the treatment. The significant within-group effect was maintained after 3 and 6 months with medium to large effect sizes.	24.4% T1 25.9% T2 27.6% T3
Suzuki et al. 2008 (99) Japan #	2 arms Duration: 2 weeks Follow up: 3 weeks Study setting: employees from companies in Okayama and Shizuoka and at Okayama University	Randomization of 43 Male rate: 61.0% Mean age: 39.6 Education: -	community	I: CBT via PC and mobile phone CC: Waitlist	No	PSQI (120) K6 (118), Japanese version	No significant effects were observed for sleep quality and mental health measured by the PSQI and K6.	9.3% T1 30.2% T2
Taylor et al. 2017	3 arms Duration: 6 weeks Follow up:	Randomization of 100 Male rate: 83%	-	I: Internet CBT I2: in-person CBT CC: Weekly	No	ISI (112)[52]	Both intervention groups reported significantly greater	14% T1 66% T2

[47] Not included in the meta-analysis because of an active control condition.
[48] Visual Analogue Scale (VAS).
[49] Pittsburgh Sleep Quality Assessment (PSQI).
[50] FFMQ-4 (describing, acting with awareness, nonjudging, nonreacting).
[52] Insomnia Severity Index (ISI).

USA (96) @[51]	6 months Study setting: 100 active duty US Army personnel at Fort Hood, Texas	Mean age: 32.73 Education: 62% some college degree		phone call assessments			improvements than the control group across the majority of assessed sleep parameters. The effect sizes for in-person CBT were consistently higher than those for Internet CBT.	
Thiart et al. 2015 (70) Germany ~	2 arms Duration: 8 weeks Follow up: 6 months Study setting: teachers at primary, secondary, and vocational schools with ≥15 on the ISI	Randomization of 128 Male rate: 25.8% Mean age: 48.0 Education: 100% university degree	community	I: Digital CBT supported by trained coaches CC: Waitlist	Yes	ISI (112)	Insomnia severity decreased significantly in the IG group with a large effect after treatment, and the large effect was maintained at the follow up.	7.8% T1 11.7% T2
Van Drongelen et al. 2014 (92) Netherlands	2 arms Duration: - Follow up: 3 and 6 months Study setting: pilots from an internationally operating airline company	Randomization of 502 Male rate: 93.2% Mean age: 40.9 Education: -	workplace	I: Mobile intervention providing personalized advice to reduce fatigue and improve sleep CC: Website with standard information on fatigue	No	JSEQ (133)[53]	The IG showed significant improvements in sleep quality after 3 and 6 months with small effects compared with the control group.	19.3% T1 22.4% T2
Abbott et al. 2009 (81) USA #	2 arms Duration: - Follow up: 10 weeks Study setting: sales managers from an Australian industrial organization based in home offices	Randomization of 53 Male rate: 86.8% Mean age: 43.3 Education: 49.2% postgraduate-level educated	workplace	I: Online resilience training based on cognitive therapy CC: Waitlist	No	DASS-21 (111) QOL psychological of WHOQOL-BREF (134)[54]	There were no significant differences between the groups for the depression, anxiety, stress or quality of life measures.	41.5% T1
Bolier et al. 2014 (63)	2 arms Duration: 3 months	Randomization of 1140	workplace	I: Personalized feedback on mental health	No	MHC-SF	The intervention significantly enhanced	64.6% T1

[51] Not included in the meta-analysis because of an active control condition.
[53] Jenkins Sleep Evaluation Questionnaire (JSEQ).
[54] The World Health Organization Quality of Life-BREF (WHOQOL-BREF).

Nether-lands	Follow up: 6 months Study setting: nurses and allied health professionals employed at one academic hospital	Male rate: 20.2% Mean age: 40.0 Education: -		and a matched offer of an online self-help mental health intervention CC: Waitlist		(135)[55] § depression and anxiety subscales - BSI (136)[56]	positive mental health compared with the control group with small effects at posttest and at follow up. No significant or relevant differences between groups were found for the secondary outcomes.	81.7% T2
Borness et al. 2013 (37) Australia @[57]	2 arms Duration: 16 weeks Follow up: 6 months Study setting: white collar employees of a large Australian public sector organization	Randomization of 135 Male rate: 36.4% Mean age: 41.6 Education: 13.7 years of education	work-place	I: Online cognitive training CC: Documentaries about the natural world	No	QOLS (137)[58] DASS-42 (111)	There were no significant effects on well-being immediately after the training. At the 6-month follow up, the control group experienced a significant increase in self-reported QOLS, a decrease in stress levels, and overall improvement in psychological well-being with small effects.	25.9% T1 34.8% T2
Feicht et al. 2013 (97) Germany °°	2 arms Duration: 7 weeks Follow up: 11 weeks Study setting: 2 departments of a local insurance company	Randomization of 147 Male rate: 31.2% Mean age: 37.2 Education: -	work-place	I: Web-based happiness training CC: Waitlist	No	WHO-5 (138) SWS (139)[59] FMI (140)[60]	-	12.2% T1 19.0% T2
Myers et al. 2017 (88) USA °° $$ @[61]	2 arms Duration: 4 weeks Follow up: 8.5 weeks	Randomization of 479 Male rate: 24% Mean age:	work-place	I: Online intervention that uses interactive and scenario-based learning	No	I COPPE (141)[62]	The IG showed no significant differences from the control	36.7% T1 40% T2

[55] *The Mental Health Continuum-Short Form (MHC-SF).*
[56] Brief Symptom Inventory (BSI).
[57] Not included in the meta-analysis because of the lack of data.
[58] *Quality of Life Scale (QOLS).*
[59] Stress Warning Signal Scale (SWS).
[60] Freiburg Mindfulness Inventory (FMI).
[61] Not included in the meta-analysis because of an active control condition.
[62] I COPPE Scale, a scale developed by the authors that incorporates overall as well as Interpersonal, Community, Occupational, Physical, Psychological, and Economic well-being.

	Study setting: employees at a major research university in southeastern USA	41.8 Education:47.7% had a graduate degree		to promote growth in subjective well-being CC: CAU with 30 days of 24-hour access to a webpage that provided links to several well-established websites			group. Considering actual participation in the intervention, significant improvements in interpersonal well-being at follow up, community well-being at posttreatment and follow up, psychological well-being at follow up, and economic well-being at posttreatment and follow up were found.	
Neumeier et al. 2017 (89) Germany $$	3 arms, first and WL were included in the meta-analysis Duration: 2 weeks Follow up: - Study setting: general working population	Randomization of 431 Male rate: 32.7% Mean age: 41.2 Education: 73.3% post-graduate-level educated	community	I1: Online positive psychology intervention based on Seligman's well-being theory I2: Online gratitude intervention CC: Waitlist	No	GSWB (142)[63]	Participants in both IGs reported significant increases in well-being after the intervention with small effects compared with the control group. The significant increases had small effect sizes for general subjective well-being and moderate effect sizes for work-related subjective well-being.	29.7% T1
Yuan et al. 2015 (103) Hong Kong $$	2 arms Duration: 4 weeks Follow up: 1 and 3 months Study setting: employees of medium and large companies in Hong Kong	Randomization of 321 Male rate: 23.7% Mean age: 34.99 Education: 78.82% highly educated, bachelor's degree or above	community	I: Online cognitive training CC: Waitlist	No	*WEMWBS* (143)[64] *CES-D* (108)	The intervention was effective for mental well-being and work engagement with small effect sizes at posttreatment and follow up; however, it did not show significant effects for any other outcomes.	48.5% T1 51.7% T2 55.8% T3
Mindfulness & Burnout								

[63] General subjective *well-being (GSWB).*
[64] Warwick-Edinburgh Mental Well-being Scale (WEMWBS).

Aikens et al. 2014 (82) USA	2 arms Duration: 7 weeks Follow up: 6 months Study setting: employees of Dow Chemical Company in Midland, Michigan	Randomization of 90 Male rate: - Mean age: - Education:-	workplace	I: The mindfulness intervention consisted of a program combining live, weekly, hour-long virtual class meetings with accompanying online applied training CC: Waitlist	Yes, virtual class meetings	FFMQ (123)[65] § PSS-14 (104)	The IG had significant decreases in perceived stress and increases in mindfulness with moderate effects. At the follow up, the IG maintained significant improvements in mindfulness (within-group effect).	13.3% T1 31.1% T2
Jonas et al. 2017 (83) Germany ~ °°	2 arms Duration: 4 weeks Follow up: 3, 6 and 12 months Study setting: general working population with a relevant level of work-related emotional exhaustion or cynicism (scoring 3.5 or higher on the related MBI-EE or MBI-cynicism scales)	Randomization of 39 Male rate: 51.3% Mean age: 46.5 Education: 78.82% highly educated, bachelor's degree or above	community	I: CBT-based intervention for burnout CC: Waitlist	Yes	MBI-GS (105)[66]§ DASS-21 (111) German version	After three months, intervention users had significantly lower values for depression and cynicism and significantly higher values for professional efficacy with medium to large effects. Those effects were sustained after 12 months and yielded a moderate within-group effect size for cynicism and a large within-group effect for depression.	7.7% T1 12.8% T2 23% T3
Rexroth et al. 2017 (93) Germany #	2 arms Duration: 3 weeks Follow up: 5 weeks Study setting: general working population	Randomization of 412 Male rate: 28.9% Mean age: 41.41 Education: -	community	I: Online mindfulness-based intervention (boundary management) CC: Waitlist	No	CAMS-R (144) OLBI (145)[67]	The IG significantly improved boundary management and emotional exhaustion, negative affect, and overall life satisfaction with small effects. The IG maintained the enhancement at follow up for	45.7% T1 63.5% T2

[65] Five Facets of Mindfulness Questionnaire (FFMQ).
[66] Maslach Burnout Inventory-General Survey (MBI-GS).
[67] Oldenburg Burnout Inventory (OLBI)

							boundary management and emotional exhaustion.	
Alcohol								
Boß et al. 2017 (76) Germany ~ 2 arm included in the analysis (unguided)	3 arms Duration: 5 weeks Follow up: 6 months Study setting: general working population consuming at least 21/14 weekly SUA and scoring ≥8/6 on the Alcohol Use Disorders Identification Test	Randomization of 434 Male rate: 59.4% Mean age: 47.0 Education: 67.6% high educational level	community	I1: Web-based modules including personalized normative feedback, motivational interviewing, goal setting, problem-solving and emotion regulation. I2: Intervention with an individually assigned psychologist who provided adherence-focused guidance. CC: Waitlist	Yes, 2 arm	Total weekly alcohol consumption in SUA[68]§	Both IGs showed small, significant improvements in reducing alcohol consumption after treatment and at the follow up compared with the controls. There was no significant difference between the unguided and guided interventions.	21.9% T1 37.6% T2
Brendryen et al. 2017 (48) Norway ~ °° @[69]	2 arms Duration: up to 6 months Follow up: 2 and 6 months Study setting: at risk drinkers with ≥3 FAST score employed at public hospitals, municipal departments, consulting company	Randomization of 85 Male rate: 51.7% Mean age: 43.0 Education: people with higher education were overrepresented in the sample	workplace	I: Personalized feedback followed by 62 web-based sessions with CBT elements with reminder e-mails and mobile phone text messages CC: Personalized feedback and e-booklet about the effects of alcohol	No	Total weekly alcohol consumption with SUA§	At the two-month follow up, a small, significant treatment effect was found for the IG, but this effect was not replicated with an intent-to-treat approach to the analysis.	34.0% T1 40.0% T2
Doumas et al. 2008 (35) USA # $$ @[70]	3 arms Duration:15 min/30 min Follow up: 30 days Study setting: young (18-24) adults in the workplace at five local companies	Randomization of 196 Male rate: 27.0% Mean age: - Education: 75.0% attending school	workplace	I1: Web-based program with personalized feedback I²: Web-based program plus a 15-minute motivational interview with a counselor CC: Waitlist	No	Weekend drinking, peak consumption, binge drinking	Participants in both IGs reported significantly lower levels of drinking with small to moderate effects than the control group. The effect was enhanced for participants	36.7% T1

[68] SUA (standard alcohol unit). One SUA contains 10–12 grams of pure alcohol.

[69] Not included in the meta-analysis because of an active control condition.

[70] Not included in the meta-analysis because the validity of the outcomes was not reported.

							classified as high-risk drinkers at the baseline assessment. No significant differences between the two interventions types were found.	
Khadjesari et al. 2014 (68) UK ~ @[71]	2 arms Duration: - Follow up: 3 months Study setting: employees of a UK-based private sector organization with ≥5 on the AUDIT-C[72]	Randomization of 1330 Male rate: 75.5% Mean age: 48.0 Education: -	workplace	I: Online personalized feedback on alcohol intake in the context of a health check with the option of a more extensive intervention CC: Waitlist with general online health check	No	Total weekly alcohol consumption with UK units (1 UK unit=8 g of ethanol) §	Alcohol consumption was 5.6% higher in the IG than in the CG, although this was not statistically significant.	19.8% T1
Matano et al. 2007 (34) USA # ~ $$ @[73]	2 arms Duration: 90 days (access to the website) Follow up: 3 months Study setting: employees with low and moderate risk for alcohol at a worksite in Silicon Valley, California	Randomization of 173 Male rate: 22.1% Mean age: 39.94 Education: 84% college or university educated	workplace	I: Website with full individualized feedback, recommendations, mini-workshops, a drinking journal, and links to online resources CC: Website with limited individualized feedback	No	Ten items assessing alcohol consumption	The intervention showed significant effectiveness in reduction of hard liquor and beer binges in the low-risk group and beer binges in the moderate-risk group with moderate effects.	16.2% T1

- no primary outcomes defined; ~ - at risk population; °° - conflict of interest declared; $$ - incentives offered; @ - not included in meta-analysis; § - primary outcome; g - Hedges' g between groups; T1 - posttreatment; TX - follow up X.

[71] Not included in the meta-analysis because of an active control condition.

[68] AUDIT-C is a 3-item alcohol screen; [2]Fast Alcohol Screening Test (*FAST*).

[73] Not included in the meta-analysis because the validity of the outcomes was not reported.

3 Preferences for e-mental health interventions in Germany: a discrete choice experiment

3.1 Introduction

The prevalence and awareness of mental health problems are increasing globally, creating challenges for health systems in their allocation of scarce health care resources (1). In industrialized countries, people seeking psychological treatments often face long waiting times (2, 3). Germany, where the prevalence of mental health illnesses was estimated to be 27.8% in 2018 (4), is no exception in this regard, and individuals wait an average of 19.9 weeks after first contacting a provider before they receive psychological treatment (5). In light of such challenges, e-mental health interventions (eMHIs), also called online- or web-based interventions[74], are considered to be promising treatment options or add-ons thanks to their flexible modes of delivery, low costs, and low barriers to access (2, 3). Such interventions can be broadly defined as the use of information and communication technologies (ICT) in the field of mental health (6).

eMHIs are delivered mostly through online platforms accessible via personal computers, tablets, or smartphones (7) and are commonly based on established psychotherapeutic approaches, such as cognitive behavioral theory (CBT), mindfulness-based cognitive therapy (MBCT), or acceptance and commitment theory (ACT) (6, 7). They typically aim to improve overall psychological well-being and treat psychological conditions, such as psychological distress, burn-out, depression, anxiety, insomnia, eating disorders, or problematic substance use (6, 7). eMHIs are recommended mainly for mild to moderate symptoms across psychological conditions (8). Although eMHI are designed primarily as self-help interventions, they often incorporate additional personal guidance from a therapist via e-mail, text messages, chat

[74] In the following, the terms “e-mental health interventions”, “online interventions”, and “online psychological treatment” are used interchangeably.

clients, video chat, or telephone (7, 9). eMHIs may also be used alongside or after traditional face-to-face psychotherapy as part of so-called blended interventions (10).

eMHIs have been found to be effective in improving mental health, and studies on the subject have reported effect sizes comparable to those seen for traditional, face-to-face psychotherapeutic interventions (3, 11, 12). In addition, some studies have found that blended interventions increase the overall effectiveness of treatment (13). Although eMHIs offer certain advantages in terms of accessibility and flexibility, their acceptability among patients is still limited compared to face-to-face psychotherapy (14-18). Indeed, Musiat et al. reported that while patients were aware of the potential advantages of eMHIs, including convenient access and short waiting times, they perceived such interventions as being less helpful than treatment delivered face to face by a health professional (16). Similar results were reported by Becker (2016), who surveyed young adults in Germany and found that eMHIs were regarded as less effective than traditional psychotherapy and therefore as an inadequate replacement for it (18). Similar conclusions have been drawn by Apolinario-Hagen based on the results of several other recent surveys in Germany (19-21).

The reasons for these unfavorable perceptions of eMHIs are still unclear. One of the complicating factors is that there is no consistent understanding or definition of such interventions. Moreover, whereas most previous surveys have described eMHIs to participants in a general way (16, 18, 21), only one to date has asked respondents specifically about their attitudes towards guidance (19). Consequently, it is unclear what kind of eMHI the participants in such surveys had in mind when they were asked about their views on the subject. Furthermore, while previous research on the acceptance of eMHIs has collected data on the sociodemographic characteristics of participants (19), it has not considered participants' previous experiences with face-to-face psychotherapy or mental health services – both of which might affect their perceptions of eMHIs.

To address these gaps in previous research, we conducted a discrete choice experiment (DCE) to identify which components of eMHIs are preferred by people with or without previous experience of psychotherapy. The DCE format entails a choice between hypothetical eMHI treatment options, thus making eMHIs more tangible to participants in comparison to conventional survey techniques. Knowing which characteristics of an eMHI are preferred by patients can help product developers, mental health practitioners, and policy makers understand why people still hesitate to use such interventions and what can be done to increase their acceptability.

3.2 Methods

We developed and administered the DCE in four main steps: (1) constructing attributes and levels for the experiment; (2) generating the experimental design and survey; (3) piloting the survey; and (4) collecting data.

3.2.1 Development of attributes and levels

We used a stepwise qualitative approach to develop attributes and levels for the DCE. First, we identified likely causes of positive attitudes and skepticism towards eMHI by reviewing the relevant literature. We then employed the unified theory of acceptance and use of technology (UTAUT), formulated by Venkatesh (22), to structure our findings and select a preliminary set of attributes and levels. Subsequently, we conducted semi-structured interviews with five experts from research and practice (two researchers on eMHI, two psychotherapists with CBT and existentialist therapy background and one developer of eMHI), and used the insights gained from these to validate and refine our selection of attributes and levels.

According to the UTAUT, there are four core determinants of users' behavioral intention to use a technology: performance expectancy, effort expectancy, social influence, and facilitating conditions (22). Performance expectancy is the degree to which individuals believe that

using a technology will help them reach their goal. According to previous research, this is the strongest and most robust predictor of behavioral intention (22, 23). Previous research has also shown that a perceived low performance expectancy, expressed in the belief that eMHIs are inferior to face-to-face treatment, is the main barrier to acceptance. For this reason, we included the attribute *proven effectiveness* in our DCE design (16). Effort expectancy is defined as the degree to which individuals perceive a technology as being easy to use. Because most eMHIs usually require only of a couple of hours of a patient's time per week, we did not consider the aspect of time further. Effort expectancy also depends, however, on individuals' learning styles, which can be described as the ways in which they retrieve, comprehend, and conceptualize information. According to the VARK model, there are four primary types of learners: visual, auditory, reading/writing, and kinesthetic (24). Because different eMHIs might favor certain learning styles, and because this might influence an individual's intention to use an eMHI, we included the attribute *content delivery* in our survey (25, 26). Social influence, in turn, is the degree to which individuals perceive that the people who are important to them believe that they should use a technology. We have excluded SI from our considerations because the degree of familiarity with eMHIs in Germany is currently very low (15, 21). Lastly, facilitating conditions are defined as organizational and technical infrastructure that supports the use of technology (22). Because an important facilitating condition identified in previous research on eMHIs is human contact (16, 20), we have included this as an attribute in our survey. It is important to bear in mind, however, that such contact does not need to take the form of human guidance, for example through a psychotherapist. Online peer support can also play a critical, ongoing role in providing social connections for individuals with mental health problems, especially for those living in rural and remote areas (27). There is some evidence that participating in web-based support groups increases adherence and motivation (14, 28) and can also be beneficial in reducing symptoms of stress (29). We therefore included the

attribute *peer support* in our survey. Another facilitating condition is familiarity with technology, which alongside low comfort with using such interventions was mentioned as a barrier to acceptance (14, 21). We therefore also included the attribute *introduction training* in our survey. Furthermore, we added the attribute *costs* to capture the individual costs associated with the intervention, (make the choice tasks more realistic, and give us the option of being able to estimate willingness to pay in our analysis. The final experimental design included six attributes with two to four levels each (see Table 3-1). We selected the levels for attributes one, two, three, and five to include the most common specifications of e-mental health apps. We chose levels for the price attribute based on the spread of current prices for eMHIs in Germany.

Table 3-1: Description of attributes and levels

Attribute	Level	Description
1. Introductory training	Online; via phone; face-to-face meeting in a group	Refers to a one-hour introductory training session explaining how the therapy program works. The training can be offered in different formats: an online learning program (self-learning), individually by phone with a coach, or locally in a group of potential users facilitated by a coach.
2. Human contact	No human contact; via e-mail; via phone; via video call, face to face in context of blended care.	Refers to contact with a person with training in psychology during the online therapy session. The contact was defined as one phone call or video chat of 30 minutes' duration per week, or a one-hour psychotherapy session once per week in the context of blended care.
3. Peer support	No peer support; online community; online community plus organized local meetings	Refers to the voluntary option to interact with other users of the online therapy program in a moderated online community or in a moderated online community accompanied by coach-led group meetings on site (once per month).

4. Proven effectiveness	Yes; not yet	Refers to whether the effectiveness of the online therapy program has been confirmed in scientific studies. Please note that if the effectiveness is set to "Not yet", it may mean that the program is effective but there is not yet sufficient evidence this is the case.
5. Mode of content delivery	Predominantly text-based; audio-based; video-based; game-based	Refers to the predominant mode by which the content of the online therapy program is delivered; usually all modes are offered to varying degrees.
6. Costs	0; 69.90 EUR; 99.90 EUR; 179.90 EUR	The price of the program per month. The price is 0 EUR if the program costs are covered by health insurance. The minimum duration of the program was set to one month, but it could be extended as needed.

3.2.2 Choice tasks and experimental design

We constructed the choice tasks using full-profile, unlabeled, paired comparisons. We did not include an opt-out option in order to increase the amount of information collected and to avoid interpretation bias (30). We constructed two context scenarios to test for differences in preferences between a "prevention group" and a "mental health condition group". Figure 3-1 presents an example choice task, including the two context scenarios, to which equal numbers of respondents were randomized.

Figure 3-1: Example of a DCE choice task

Scenario "Prevention": Please consider the following scenario: You feel irritable, burnt out, and unmotivated. Your everyday life is dominated by feelings of exhaustion and fear of failure. To cope better with these feelings, you aim to improve your mental health. It is possible to learn mindfulness or relaxation techniques using preventive online therapy programs for PCs, tablets, or smartphones (apps). Please select which one of the two types of online therapy program you would prefer.

OR

Scenario "Depression": You have felt tired, depressed, and stressed over the past few months. You are irritable, moody, and have trouble sleeping. Your doctor has told you that you may develop depression. It is possible to treat mild and moderate depression effectively with online therapy programs using PCs, tablets, or smartphones (apps). Please select which one of the two types of online therapy program you would prefer.

	Option A	**Option B**
Introductory training	Live with a trainer on site	Via online self-learning tour
Human support	No contact	Via telephone
Proven effectiveness	Yes	Not yet
Peer support	Online community plus group meetings on site	Online community
Learning style	Mostly audio-based	Mostly game-based
Costs	179.90 EUR	99.90 EUR

To reduce the choice tasks to a manageable number, we used a fractional factorial design (31). To maximize the precision of the parameter estimates, we generated a D-efficient Bayesian design using the JMP software from the SAS Institute. The design was optimized for main effects, with all attributes coded categorically and priors based on a pre-test. There were 16 choice tasks administered in one block.

3.2.3 Survey design

The survey, which was generated using Unipark software (Unipark, Berlin, Germany), started by informing respondents about the aim of the study. Before presenting respondents with the

DCE choice tasks, the survey asked questions about sociodemographics; attitudes and previous experience with traditional psychotherapy and online mental health interventions; and respondents' stress level, measured using the Kessler-6 questionnaire (32). To familiarize respondents with the DCE elicitation format, the survey provided a detailed explanation of the types of questions that would be asked followed by a straightforward warm-up choice task. Additionally, each of the attributes and levels of the main DCE was explained in narrative fashion before the choice tasks. Modes of content delivery were also described narratively, as we did not want to influence participants with visual stimuli. After completing the 16 choice tasks, participants were asked to evaluate the difficulty of the tasks and whether there were components of eMHIs that they would have liked to have seen included in the experiment.

3.2.4 Study pilot

We conducted a pre-test of the experiment with 128 respondents recruited from the online survey platform Prolific.ac and used the data obtained doing so to assess whether respondents had understood the experiment and were able to handle the 16 choice tasks. Furthermore, we asked about the appropriateness of the attributes and levels used in the experiment and whether relevant elements of eMHIs were lacking. We subsequently used the results from the pre-test to refine the survey and inform the priors of the Bayesian D-efficient design.

3.2.5 Data collection

We administered the survey online through a market research agency (Norstat, Munich, Germany), and data collection took place in November 2019. A sample of 2,000 respondents from Germany was targeted in order to provide sufficient statistical power for the main analysis and several subgroup analyses based on a rule of thumb calculation proposed by Johnson and Orme (33). Differentiating between respondents who had experience of psychotherapy and those who were naïve to it was of special interest. Because we anticipated that there

would be a low number of the former, we intentionally oversampled this group. We collected explicit and informed consent from respondents after providing them with a detailed explanation of how their personal data would be used. The respondents received a small monetary compensation from the market research agency.

3.2.6 Statistical analysis

We assessed the cognitive burden of the choice experiment based on self-reported difficulty. To examine choice heuristics in terms of dominant attributes, we calculated lexicographic scores. This entailed counting the proportion of choices based on one attribute. Following previous literature, we considered a respondent to have dominant preferences for one attribute if the lexicographic score was 90% or higher (34). As was discussed by Hess et al. (35), lexicographic responses can arise for different reasons, with true lexicographic behavior being difficult to detect, and no straightforward way of accounting for such responses in the analysis. To test whether responses from the two versions of the survey, as well as responses from individuals with experience of or naïve to psychotherapy, could be pooled together, we examined scale heterogeneity using the Swait-Louviere test (36).

We analyzed DCE responses using main effects multinomial and mixed logit models, having chosen the latter to test for preference heterogeneity and circumvent the IIA assumption (37). Using the Akaike Information Criteria (AIC), we tested whether including the price attribute as a linear variable improved model fit. All categorical variables were dummy coded, with the most negative expected level defined as the reference category. Respondents with incomplete choice data were excluded from the analysis.

We specified the mixed logit model using 1,000 Halton draws, setting all variables, except the cost levels, to be random and normally distributed because heterogeneity was found in these attributes. The cost levels were included as categorical variables because a linear specification

reduced model fit. In the mixed logit, cost variables were furthermore specified as fixed parameters because specifying them as randomly distributed would complicate the calculations of willingness to pay. To examine variation in preferences, individual level preference estimates were calculated using the mixlbeta command in Stata. Marginal effects, i.e. the change in probability of choosing one of the two intervention profiles if only one attribute level is changed, were calculated as the differences in the predicted choice probabilities, estimated using the mixlpred command in Stata. To investigate heterogeneity in preferences for certain sociodemographic, mental health (care) related, or attitudinal groups, we interacted subgroup indicators with all main effects parameters. The interaction terms were specified as fixed parameters to retain feasible computation times. To assess whether preferences differed, we conducted χ^2tests for joint significance. Standard errors were clustered at the respondent level throughout the analysis. We performed all calculations using Stata 15 (StataCorp, College Station, TX).

3.3 Results

3.3.1 Respondent characteristics

A total of 1,984 respondents completed the survey. Summary statistics of the study sample (N=1,984) are given in Table 3-2. The sample was well balanced regarding gender and age, while rather highly educated compared to the general population. Most respondents had a positive general attitude towards psychotherapy (83.0%). The proportion of respondents who could be classified as having low, moderate, or severe levels of mental distress were roughly equal in size. Of the 61.8% of sample respondents who had previous experience of psychotherapy, 72.3% evaluated this as very good or rather good. In total, 61.2% of respondents indicated that they would use an eMHI if they had a mental health problem. The main reasons reported for not opting for eMHIs were their "too impersonal" nature (52.5%), doubts regarding their effectiveness (9.2%), and a lack of interest or need (9.1%). When asked which components of the

eMHI they felt were lacking in the experiment, 62.5% of respondents stated that they did not feel that any components were lacking, whereas 14% found that personal support and 3.6% found that emergency contact details were lacking. Only 10.4% of respondents considered the survey to be difficult and 0.7% very difficult to understand and complete. The average survey completion time was 15 minutes. The market research agency did not provide us with information on the response rate.

Table 3-2: Summary statistics of survey sample

	N = 1984
Mean age in years	51.2, SD 13.3
Female	1,157 (58.3%)
Highest level of educational attainment	
Secondary general school (Hauptschulabschluss)	327 (16.5%)
Secondary school (Realschulabschluss)	813 (41%)
Academic secondary school (Abitur)	416 (21%)
University degree	428 (21.5%)
Satisfaction with monthly income	
Highly satisfied	105 (5.3%)
Satisfied	590 (29.8%)
Neither satisfied nor dissatisfied	597 (30.1%)
Dissatisfied	467 (23.5%)
Very dissatisfied	221 (11.1%)
No response	4 (0.2%)
Experience of psychotherapy or mental health counselling	1,226 (61.8%)
Evaluation of previous psychotherapy (for those with previous experience)	
Excellent	320 (26.1%)
Fine	566 (46.2%)
Neither good nor bad	227 (18.5%)
Bad	81 (6.6%)
Very bad	32 (2.6%)

K6 mental distress scale	
Low distress (0-7)	745 (37.6%)
Moderate distress (8-12)	520 (26.2%)
High risk of psychological distress (13-24)	719 (36.2%)
Used an online therapy app before	133 (6.7%)
Willing to use a therapy app in the future if needed	1,222 (61.2%)

3.3.2 Preferences results

Examining choice behavior revealed that 26.7% of respondents had lexicographic preferences, predominantly for the price attribute (90.2%). Because Swait-Louviere tests did not reject the null-hypothesis of equal attribute level estimates, we were able to pool observations across the two outlined scenarios and from individuals with and without experience of psychotherapy. The mixed logit model provided evidence of preference heterogeneity for all attributes and was superior in terms of model fit. Therefore, we report only the mixed logit preference estimates in the following, which are summarized in Table 3-3 and Figure 3-2.

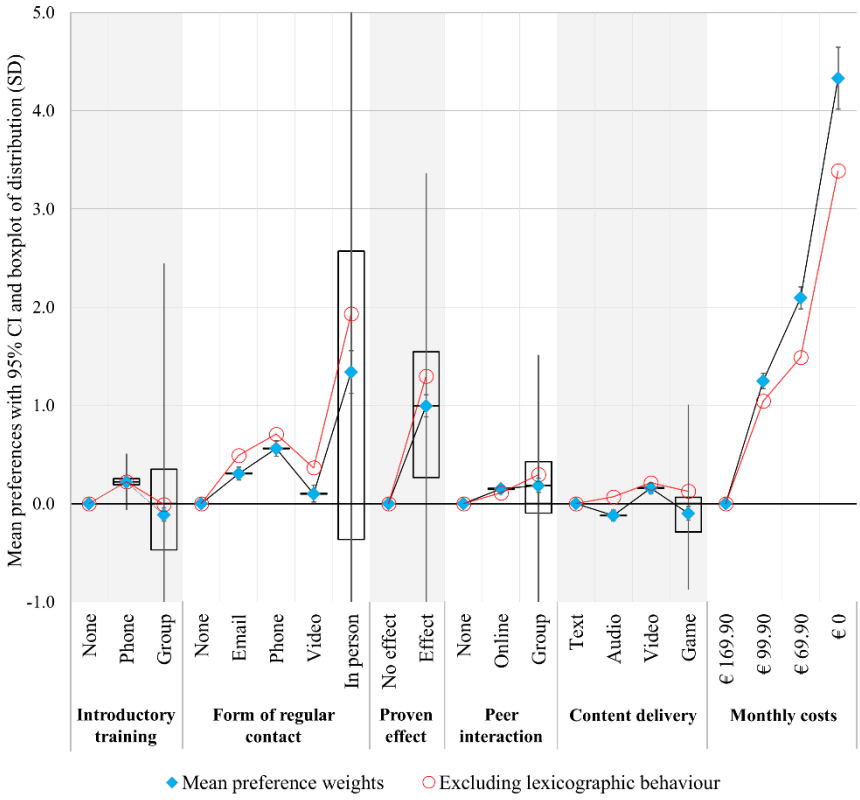
Table 3-3: Mixed logit estimates and marginal effects for the full sample

	Preference estimates				**Marginal effect**
Attributes and levels	**Coefficient**	**95% CI**	**SD**	**95% CI of SD**	
Introductory training					
None	Reference				Reference
Phone	0.22	0.17 to 0.27	0.15	-0.05 to 0.35	3.4%
Group	-0.11	-0.18 to -0.04	1.07	0.99 to 1.15	-1.2%
Form of regular contact					
None	Reference				Reference
Email	0.31	0.24 to 0.37	-0.01	-0.03 to 0.01	4.5%
Phone	0.56	0.48 to 0.64	0.00	-0.03 to 0.04	8.2%
Video	0.10	0.01 to 0.19	0.02	-0.06 to 0.10	1.5%
In person	1.34	1.12 to 1.56	2.24	2.07 to 2.40	18.0%
Proven effectiveness					
No evidence (yet)	Reference				Reference
Evidence	1.00	0.89 to 1.11	1.21	1.11 to 1.30	14.8%
Peer interaction					
None	Reference		0.00		Reference
Online	0.15	0.11 to 0.19	-0.02	-0.06 to 0.03	2.3%

Group	0.19	0.11 to 0.26	0.68	0.60 to 0.75	2.9%
Form of content delivery					
Text	Reference				Reference
Audio	-0.12	-0.17 to -0.07	0.00	-0.02 to 0.02	-1.8%
Video	0.16	0.10 to 0.21	0.02	-0.01 to 0.04	2.4%
Game	-0.10	-0.17 to -0.03	0.48	0.39 to 0.57	-1.4%
Monthly costs					
€ 169.90	Reference				Reference
€ 99.90	1.25	1.17 to 1.33			18.6%
€ 69.90	2.10	1.98 to 2.21			31.6%
€ 0	4.33	4.01 to 4.64			56.9%
Constant	-0.187	-0.24 to -0.13	0.37	0.30 to 0.44	
Log likelihood	-18,358				
AIC	36,774				
BIC	37,036				
Observations	1,984				

Note. Attributes were dummy coded. Coefficients refer to the mean preference estimates and standard deviations (SD) to the distribution around the means. Uncertainty around mean and SDs is shown using 95% confidence intervals (CI).

Figure 3-2: Mean preferences with 95% CI and boxplot of distribution (SD)



Preference estimates for eMHI. Point estimates of full model are diamonds bounded by 95% CIs. Box plots indicate the distribution of individual preference weights in the population with the boxes presenting the interquartile range and the vertical lines representing the 95% CIs of the SDs. Red circles indicate point estimates of model for respondents without lexicographic behavior.

All but one of the attribute levels (audio content delivery) were significantly different from their respective reference categories at the 5% level, thus indicating that all attributes were relevant to respondents. Most preference estimates behaved as was to be expected a priori: Regular face-to-face contact, evidence of an intervention's effectiveness, a higher degree of peer interaction, and lower costs were preferred by respondents compared to the respective reference categories. The largest preference estimates were found for the cost levels (1.25, 2.10, 4.33), the face-to-face level of the mode of contact attribute (1.34), and the proven effectiveness attribute (1.00). The type of introductory training, peer interaction, and the mode of content delivery were of less relevance to respondents, with small coefficient estimates and low preference heterogeneity.

The degree of preference heterogeneity, as indicated by the boxplots in Figure 2, which show the interquartile range of the individual level preference estimates and the 95% CI of the SDs, was largest at the following group levels: face-to-face contact, proven effectiveness, introductory training, and peer interaction. Only small variance in preferences was found in general at most attribute levels. The largest marginal effects – ie, the changes in the probability of choosing an alternative compared to the respective reference level – were found for face-to-face contact (18.0%), proven effectiveness (14.8%), and the cost levels, reaching 56.9% when monthly costs of €169.90 were shifted to €0.

3.3.3 Sensitivity to excluding lexicographic behavior

The large share of individuals with near-lexicographic behavior (26.7%) deserved further attention because this could be indicative of respondents not trading-off between attributes, which could bias our estimates. Lexicographic heuristics in our study could have originated from forcing respondents to choose between interventions they would not consider to begin with, leading them to select the lowest cost option. To test the sensitivity of our main estimates to such behavior, we interacted a dummy variable identifying respondents with lexicographic behavior with all main effects. Plotting the non-lexicographic estimates against our main estimates (Figure 2) revealed certain differences, especially with regard to the importance of the cost levels. However, these differences were rather small and did not contradict the main implications of the base model.

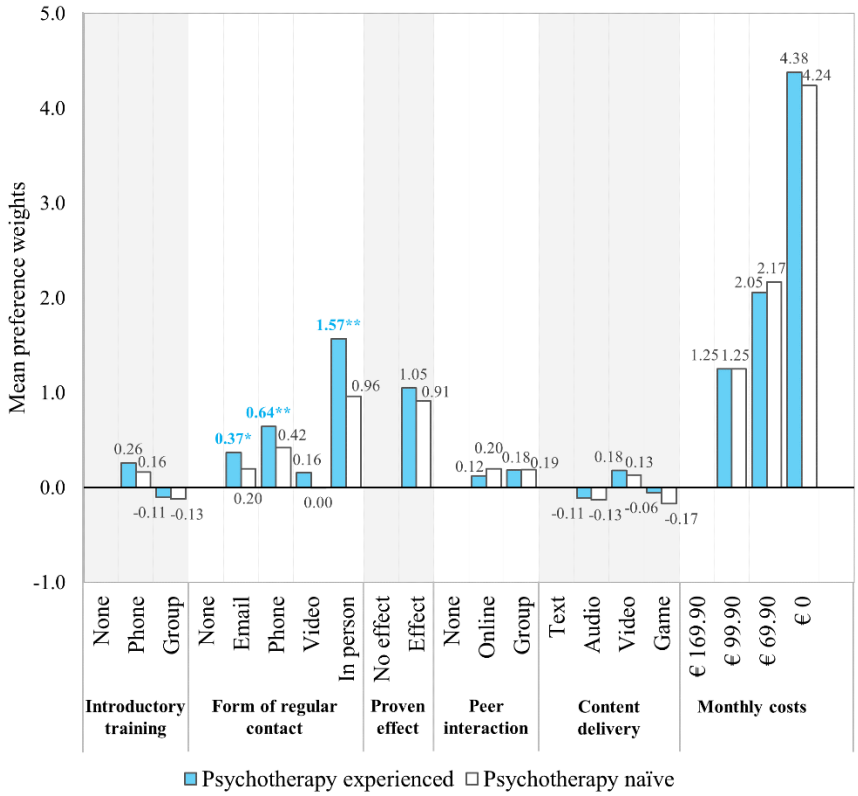
3.3.4 Scenario and subgroup results

Preferences for the different characteristics of eMHIs did not differ between the two context scenarios (see Figure 3-3), as was evident from a non-significant χ^2test for joint significance of all interaction terms (χ^2: 14.37(15), p =0.498). Preference estimates for individuals with and individuals without previous experience of psychotherapy (Figure 3) deviated to a larger

extent, although the χ^2test was not significant on the 5% level (χ^2: 23.58(15), p=0.073). The experienced group put greater emphasis on having any form of regular contact during online therapy with a person trained in psychology, in general, and personal contact in particular. Regression results for this subgroup analysis can be found in Appendix 3.A Table 1. Further subgroup results are presented in Appendix 3.B. Respondents who were dissatisfied with their financial situation and those who were aged 50 years or older put greater emphasis on the cost levels. Only small differences were found between females and males. Being a frequent user of electronic devices reduced the importance of the effectiveness attribute.

Non-significant χ^2tests statistics for the subgroup interactions were found for the following groups: 1) individuals who were experiencing moderate to high levels of mental distress (K6 scale above 7) compared to their less distressed counterparts (χ^2: 22.11 (15), p=0.105) and 2) individuals with higher levels of education (academic secondary school or university) compared to individuals with lower levels of education (χ^2: 21.62 (15), p=0.118).

Figure 3-3: Mean preferences weights



Preference estimates comparing individuals with and individuals without previous experience of psychotherapy. Significance levels of subgroup interaction terms: *** p<0.001 ** p<0.01 * p<0.05.

3.4 Discussion

This paper reports on the development and analysis of a discrete choice experiment that elicited preferences towards e-mental health interventions in Germany. We selected relevant characteristics, or attributes and levels, for the experiment based on a stepwise qualitative approach, drawing upon a review of the related literature, the unified theory of acceptance and use of technology (UTAUT), and expert interviews. The design and analysis of the DCE followed published good research practices and employed a Bayesian D-efficient design, and we analyzed choice data using mixed logit models and provided subgroup results.

The study's main contributions are the following: First, the DCE format allowed us to provide information on possible causes of the unfavourable perception of eMHIs in the German population. Second, in contrast to previous studies on eMHIs, our analysis was able to differentiate between those with and those without previous experience of psychotherapy or counselling, and two context scenarios. Third, as part of a stepwise qualitative approach to generating attributes and levels for the DCE, we used a framework for product development (ie, the UTAUT) to structure the process. Fourth, this study is the first DCE that has investigated preferences for different components of eMHI in the German population.

The results of our analysis suggest a strong preference for blended care including face-to-face contact with a psychotherapist. This preference remained stable across respondents with different characteristics, including the presence or absence of past experience of psychotherapy. Our results are in concordance with those of previous research, in which participants disagreed that guided internet interventions were comparable to face-to-face psychotherapy in terms of effectiveness and the ability to develop a good therapeutic relationship (16, 19). Musiat et al. hypothesized that the perceived helpfulness of an intervention for mental health problems and the preference for personal contact might be correlated, and that the perceived superiority of face-to-face treatment could be explained with this unique component of traditional psychotherapy (16). A clear preference for conventional face-to-face treatment was also found by Eichenberg et al. in a survey of a national sample representative of the general population in Germany in 2013 (15). The strong emphasis on personal contact could be the result of traditional approaches to mental healthcare in Germany, which involve long and extensive treatments (4). Similar tendencies have been identified in a survey on attitudes towards digital treatment of depression in eight European countries,[75] in which stakeholders showed greater acceptance of blended treatment compared to standalone internet treatments (38), as well as in

[75] France, Germany, Netherlands, Poland, Spain, Sweden, Switzerland, and the United Kingdom

a recent study in the United States where 44.5% of respondents preferred in-person psychotherapy over an eMHI (39). The preference for face-to-face contact is also in line with empirical research on psychotherapy, which has found the quality of the therapeutic relationship, the so-called therapeutic alliance, to be the strongest predictor of therapeutic success (40, 41). However, first evidence on client's perceptions towards therapeutic alliance using eMHI suggest that a therapeutic relationship can also be formed in digital formats (42).

The preference in our sample for phone communication over other forms of electronic interaction might be explained by it being more personal compared to asynchronous e-mail communication, and more traditional compared to video chats or video conferencing. Given the dramatic increase in video conferencing seen in the wake of the COVID-19 pandemic, both in the personal and professional spheres, it will be interesting to see whether this hesitation to use video chats has diminished since we conducted our experiment. Our results also suggest that the availability of evidence on the effectiveness of eMHIs is another important driver of people's attitudes towards such interventions. This highlights the need for scientific support and monitoring during the development and roll-out of such programs.

We also found strong preferences for lower or no monthly costs. This is probably due to two characteristics of the German (mental) health care system. First, upon access, regular psychotherapy treatment is fully reimbursed by statutory health insurance and provides quite intensive care (ie, short-term therapy comprising 25 sessions, which can be extended up to two years) (43) compared for example to the English NHS (6-12 sessions) (44). Second, there is almost no co-payment for ambulatory care in Germany, and considerable out-of-pocket spending is uncommon.

The form of the introductory training and the mode of content delivery, while relevant, were of less importance to our respondents. We found only little difference in preference estimates for video compared to purely textual content delivery. Our finding that online peer interaction is a desired feature, although of less importance, is in concordance with previous research,

which has found that peer interaction is perceived as beneficial in terms of continuous support, sense of community, personalized advice, and encouragement (45, 46).

While preference estimates were somewhat stable across most subgroups, respondents with previous experience of psychotherapy put greater emphasis on having regular contact (of any form) during online therapy with a person trained in psychology. This finding may be relevant for customizing eMHIs and thus improving their acceptance in this subgroup.

3.5 Limitations

The results of our analysis and subsequent conclusions must be interpreted in light of several important limitations. First, the share of participants in our sample who had contact with psychotherapists before the survey was 61.9%, which is a considerably higher than would be expected of a sample that is representative of the general population. Considering the largely similar result from the corresponding subgroup analysis, however, this should not have a substantial impact on the generalizability of our estimates. Nevertheless, it is likely that the high share of respondents in our sample who preferred face-to-face contact represents an overestimate this preference in the general population.

A second limitation concerns the way in which the different levels of the content delivery attribute were introduced and presented. The short and solely textual descriptions may have resulted in respondents paying less attention to this attribute because differences between delivery modes may not have been as tangible as difference between other attributes. This may have resulted in the small preference estimates we observed for the content delivery levels. In general, having a delivery mechanism that suits an individual's needs should be a relevant factor, at least in terms of future adherence to a program. Using visual representations of the different delivery modes might have yielded larger preference estimates.

A third limitation is related to our decision not to provide respondents with an opt-out option. This forced them to choose between eMHIs with relatively high monthly costs (which were

based on the prices of existing eMHIs). With 38.3% of the population stating that they would not consider using such interventions in general, this may have led to an exaggerated focus on the cost attribute while clouding preference estimates in other dimensions (47).

3.6 Conclusions

We set out to examine the underlying factors contributing to the unfavorable perception of eMHIs and their hesitant uptake in Germany. Our results suggest a clear preference for blended care including face-to-face contact with a psychotherapist. This preference remained stable irrespective of sociodemographics, previous experience of psychotherapy, distress level, and the two context scenarios used in our discrete choice experiment. This implies, in part, that the unfavorable perception of such interventions reflects more the wish for face-to-face contact than a lack of trust in the effectiveness of online treatments. While the findings of the few studies on this topic to date suggest that combining online interventions and face-to-face psychotherapy increases the overall effectiveness of treatment, this area of study is still in its infancy (10, 13). Further research is needed to investigate whether a favorable therapeutic relationship can be established via information and communication technologies. Furthermore, our results indicate that people in Germany are not willing to spend considerable amounts out of pocket for such interventions, implying that services asking prices similar to those in our experiment are too expensive. It will be interesting to observe developments in the field of eMHIs in Germany now that digital health apps can be prescribed by providers and reimbursed by statutory health insurers following the enactment of the Digital Health Act on 1 January 2020 (48).

3.7 References

1. World Health Organization. *Mental Health ATLAS 2017.* Geneva: World Health Organization, 2018.

2. Shoemaker EZ, Hilty DM: e-Mental Health Improves Access to Care, Facilitates Early Intervention, and Provides Evidence-Based Treatments at a Distance. In: Mucic D, Hilty DM, *e-Mental Health*, Basel: Springer International Publishing 2016.

3. Christensen H, Hickie IB. Using e-health applications to deliver new mental health services. *Med J Aust.* 2010; 192.

4. Deutsche Gesellschaft für Psychiatrie und Psychotherapie, Psychosomatik und Nervenheilkunde e. V. (DGPPN). *Psychische Erkrankungen in Deutschland: Schwerpunkt Versorgung.* Berlin: Buch- und Offsetdruckerei H. HEENEMANN GmbH & Co. KG, 2018.

5. Bundespsychotherapeutenkammer (BPtK). *Ein Jahr nach der Reform der Psychotherapie-Richtlinie. Wartezeiten 2018*. Berlin: BPtK, 2018.

6. Phillips EA, Gordeev VS, Schreyogg J. Effectiveness of occupational e-mental health interventions: a systematic review and meta-analysis of randomized controlled trials. *Scand J Work Environ Health.* 2019.

7. Ebert DD, Erbe D. Internetbasierte psychologische Interventionen. In: Rief W, Berking M, eds. *Klinische Psychologie und Psychotherapie*. Springer; 2012: 131-140.

8. Gun SY, Titov N, Andrews G. Acceptability of Internet treatment of anxiety and depression. *Australas Psychiatry.* 2011; 19: 259-64.

9. Baumeister H, Reichler L, Munzinger M, et al. The impact of guidance on Internet-based mental health interventions - A systematic review. *Internet Interv.* 2014; 1: 205-15.

10. Erbe D, Eichert HC, Riper H, et al. Blending Face-to-Face and Internet-Based Interventions for the Treatment of Mental Disorders in Adults: Systematic Review. *J Med Internet Res.* 2017; 19: e306.

11. Barak A, Hen L, Boniel-Nissim M, et al. A Comprehensive Review and a Meta-Analysis of the Effectiveness of Internet-Based Psychotherapeutic Interventions. *J Technol Hum Serv.* 2008; 26: 109-60.

12. Grist R, Cavanagh K. Computerised Cognitive Behavioural Therapy for Common Mental Health Disorders, What Works, for Whom Under What Circumstances? A Systematic Review and Meta-analysis. *J Contemp Psychother.* 2013; 43: 243-51.

13. Lindhiem O, Bennett CB, Rosen D, et al. Mobile technology boosts the effectiveness of psychotherapy and behavioral interventions: a meta-analysis. *Behav Modif.* 2015; 39: 785-804.

14. Ebert DD, Berking M, Cuijpers P, et al. Increasing the acceptance of internet-based mental health interventions in primary care patients with depressive symptoms. A randomized controlled trial. *J Affect Disord.* 2015; 176: 9-17.

15. Eichenberg C, Wolters C, Brahler E. The internet as a mental health advisor in Germany-results of a national survey. *PLoS One.* 2013; 8: e79206.

16. Musiat P, Goldstone P, Tarrier N. Understanding the acceptability of e-mental health--attitudes and expectations towards computerised self-help treatments for mental health problems. *BMC psychiatry.* 2014; 14: 109.

17. Lillevoll KR, Vangberg HC, Griffiths KM, et al. Uptake and adherence of a self-directed internet-based mental health intervention with tailored e-mail reminders in senior high schools in Norway. *BMC Psychiatry.* 2014; 14: 14.

18. Becker D. Acceptance of Mobile Mental Health Treatment Applications. *Procedia Comput Sci.* 2016; 98: 220-27.

19. Apolinario-Hagen J, Harrer M, Kahlke F, et al. Public Attitudes Toward Guided Internet-Based Therapies: Web-Based Survey Study. *JMIR mental health.* 2018; 5: e10735.

20. Apolinario-Hagen J, Kemper J, Sturmer C. Public Acceptability of E-Mental Health Treatment Services for Psychological Problems: A Scoping Review. *JMIR mental health.* 2017; 4: e10.

21. Apolinario-Hagen J, Vehreschild V, Alkoudmani RM. Current Views and Perspectives on E-Mental Health: An Exploratory Survey Study for Understanding Public Attitudes Toward Internet-Based Psychotherapy in Germany. *JMIR mental health.* 2017; 4: e8.

22. Venkatesh V, Morris MG, Davis GB, et al. User acceptance of information technology: Toward a unified view. *Mis Q.* 2003; 27: 425-78.

23. Dulle FW, Minishi-Majanja MK. The suitability of the Unified Theory of Acceptance and Use of Technology (UTAUT) model in open access adoption studies. *Inf Dev.* 2011; 27: 32-45.

24. Fleming ND, Mills C. Not Another Inventory, Rather a Catalyst for Reflection. *Improve Acad.* 1992; 11: 137-55.

25. Balakrishnan V, Gan CL. Students' learning styles and their effects on the use of social media technology for learning. *Telematics Inform.* 2016; 33: 808-21.

26. Cheng G, Chau J. Exploring the relationships between learning styles, online participation, learning achievement and course satisfaction: An empirical study of a blended learning course. *Br J Educ Technol.* 2016; 47: 257-78.

27. Smith-Merry J, Goggin G, Campbell A, et al. Social Connection and Online Engagement: Insights From Interviews With Users of a Mental Health Online Forum. *JMIR mental health.* 2019; 6: e11084.

28. Gliddon E, Cosgrove V, Berk L, et al. A randomized controlled trial of MoodSwings 2.0: An internet-based self-management program for bipolar disorder. *Bipolar Disord.* 2019; 21: 28-39.

29. Winzelberg AJ, Classen C, Alpers GW, et al. Evaluation of an internet support group for women with primary breast cancer. *Cancer.* 2003; 97: 1164-73.

30. Campbell D, Erdem S. Including Opt-Out Options in Discrete Choice Experiments: Issues to Consider. *Patient.* 2019; 12: 1-14.

31. Reed Johnson F, Lancsar E, Marshall D, et al. Constructing experimental designs for discrete-choice experiments: report of the ISPOR Conjoint Analysis Experimental Design Good Research Practices Task Force. *Value Health.* 2013; 16: 3-13.

32. Kessler RC, Andrews G, Colpe LJ, et al. Short screening scales to monitor population prevalences and trends in non-specific psychological distress. *Psychol Med.* 2002; 32: 959-76.

33. Orme BK. Sample Size Issues for Conjoint Analysis Studies. In: Orme BK, *Getting Started with Conjoint Analysis: Strategies for Product Design and Pricing Research*, Madison: Research Publishers, LLC, 2005.

34. Krucien N, Watson V, Ryan M. Is Best-Worst Scaling Suitable for Health State Valuation? A Comparison with Discrete Choice Experiments. *Health Econ.* 2017; 26: e1-e16.

35. Hess S, Rose JM, Polak J. Non-trading, lexicographic and inconsistent behaviour in stated choice data. *Transp Res D Transp Environ*. 2010; 15: 405-17.

36. Swait J, Louviere J. The Role of the Scale Parameter in the Estimation and Comparison of Multinomial Logit Models. *J Mark Res.* 1993; 30.

37. Hensher DA, Rose JM, Greene MH. *Applied choice analysis* (2nd ed). Cambridge: Cambridge University Press, 2015.

38. Topooco N, Riper H, Araya R, et al. Attitudes towards digital treatment for depression: A European stakeholder survey. *Internet Interv.* 2017; 8: 1-9.

39. Renn BN, Hoeft TJ, Lee HS, et al. Preference for in-person psychotherapy versus digital psychotherapy options for depression: survey of adults in the U.S. *NPJ Digit Med.* 2019; 2: 6.

40. Martin DJ, Garske JP, Davis MK. Relation of the therapeutic alliance with outcome and other variables: A meta-analytic review. *J Consult Clin Psychol.* 2000; 68: 438-50.

41. Horvath AO. *The alliance.* Psychotherapy: Theory, Research, Practice, Training. 2001; 38: 365-72.

42. Berger T. The therapeutic alliance in internet interventions: A narrative review and suggestions for future research. *Psychother Res.* 2017; 27: 511-24.

43. Pro Psychotherapie e.V. Wie viele Therapiestunden bezahlt die Krankenkasse. https://www.therapie.de/psyche/info/fragen/wichtigste-fragen/wieviele-therapiestunden-bezahlt-die-krankenkasse/, 1 April 2020.

44. NHS. Types of talking therapies. https://www.nhs.uk/conditions/stress-anxiety-depression/types-of-therapy/, 1 April 2020.

45. Coulson NS, Smedley R, Bostock S, et al. The Pros and Cons of Getting Engaged in an Online Social Community Embedded Within Digital Cognitive Behavioral Therapy for Insomnia: Survey Among Users. *J Med Internet Res.* 2016; 18: e88.

46. Richardson CR, Buis LR, Janney AW, et al. An online community improves adherence in an internet-mediated walking program. Part 1: results of a randomized controlled trial. *J Med Internet Res.* 2010; 12: e71.

47. Bateman IJR, Mandy; Gerard, Karen; Amaya-Amaya, Mabel. *Using Discrete Choice Experiments to Value Health and Health Care*. 2008.

48. Mercker U, Steffen D. Germany: the new Digital Healthcare Act (DVG). Healthcare.Digital. November 9, 2019. https://www.healthcare.digital/single-post/2019/11/09/Germany-the-new-Digital-Healthcare-Act-DVG, 1 April 2020.

Appendix 3.A Subgroup results

Table 1: Mixed logit subgroup estimates for psychotherapy-naïve vs. experienced

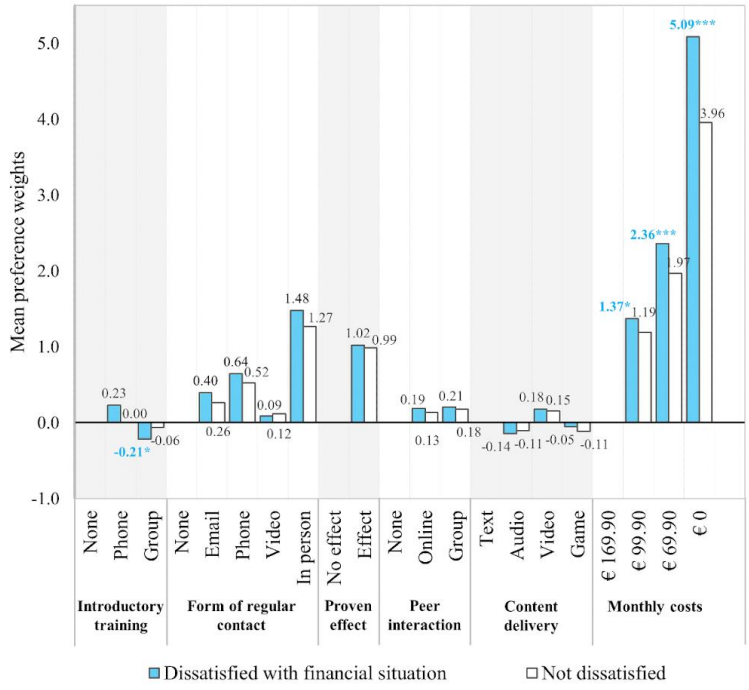
	Preference estimates			
Attributes and levels	**Coefficient**	**95% CI**	**SD**	**95% CI of SD**
Introductory training				
None	Reference			
Phone	0.16	0.08 to 0.24	0.15	-0.05 to 0.35
Group	-0.13	-0.24 to -0.01	1.07	0.99 to 1.15
Form of regular contact				
None	Reference			
Email	0.20	0.09 to 0.31	-0.01	-0.03 to 0.01
Phone	0.42	0.20 to 0.54	0.00	-0.03 to 0.03
Video	0.00	-0.13 to 0.13	0.02	-0.06 to 0.10
In person	0.96	0.60 to 1.32	2.23	2.06 to 2.40
Proven effectiveness				
No evidence (yet)	Reference			
Evidence	0.91	0.73 to 1.09	1.21	1.11 to 1.30
Peer interaction				
None	Reference			
Online	0.20	0.13 to 0.26	-0.02	-0.06 to 0.02
Group	0.19	0.08 to 0.30	0.68	0.60 to 0.76
Form of content delivery				
Text	Reference			
Audio	-0.13	-0.22 to -0.05	0.00	-0.02 to 0.02
Video	0.13	0.05 to 0.22	0.02	-0.01 to 0.04
Game	-0.17	-0.28 to -0.07	0.48	0.39 to 0.57
Monthly costs				
€ 169.90	Reference			
€ 99.90	1.25	1.12 to 1.37		
€ 69.90	2.17	1.98 to 2.35		
€ 0	4.24	3.73 to 4.75		
Psych. experienced interaction				
int_phone*exper	0.10	0.01 to 0.20		
int_group*exper	0.02	-0.12 to 0.16		
cont_email*exper	0.17	0.03 to 0.31		
cont_phone*exper	0.22	0.07 to 0.38		
cont_video*exper	0.16	-0.01 to 0.33		

cont_pers*exper	0.60	0.16 to 1.05		
eff*exper	0.13	-0.09 to 0.36		
peer_onl*exper	-0.07	-0.16 to 0.01		
peer_group*exper	0.00	-0.14 to 0.14		
cont_audio*exper	0.02	-0.08 to 0.12		
cont_video*exper	0.04	0.06 to 0.15		
cont_game*exper	0.12	-0.02 to 0.25		
price_hight*exper	0.00	-0.15 to 0.15		
price_medium*exper	-0.11	-0.33 to 0.11		
price_low*exper	0.14	-0.48 to 0.76		
Constant	-0.19	-0.24 to -0.13	0.37	0.30 to 0.44
Log likelihood	-18,337			
AIC	36,763			
Observations	1,984			

Note. Coefficients refer to the mean preference estimates and standard deviations (SD) to the distribution around the means. Uncertainty around mean and SDs is shown using 95% confidence intervals (CI). Costs and interactions specified as fixed parameters in regression.

Appendix 3.B Subgroup results visual representation

Fig. B1: Financial situation

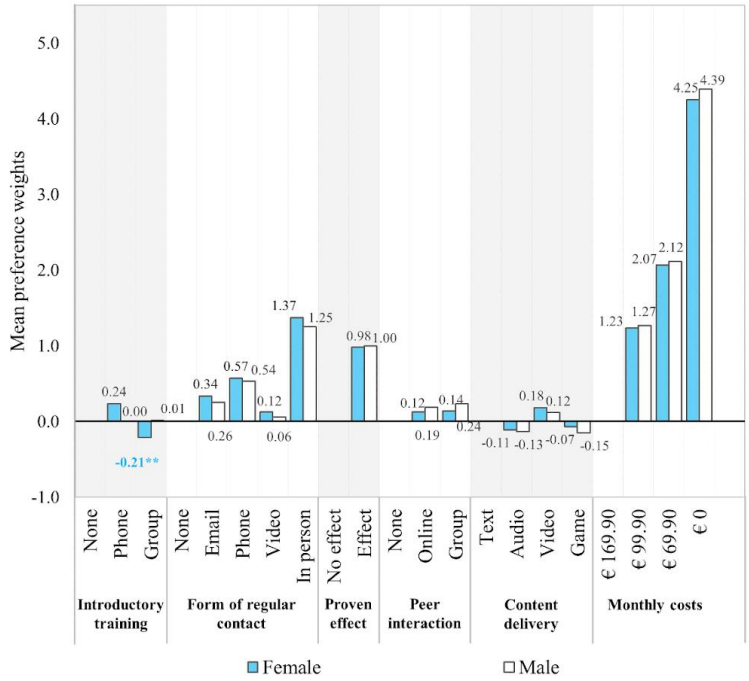


Financial situation: How satisfied are you with your current financial situation?

Dissatisfied or very dissatisfied (34.7%)

Not dissatisfied (65.3%)

Fig. B2: Gender

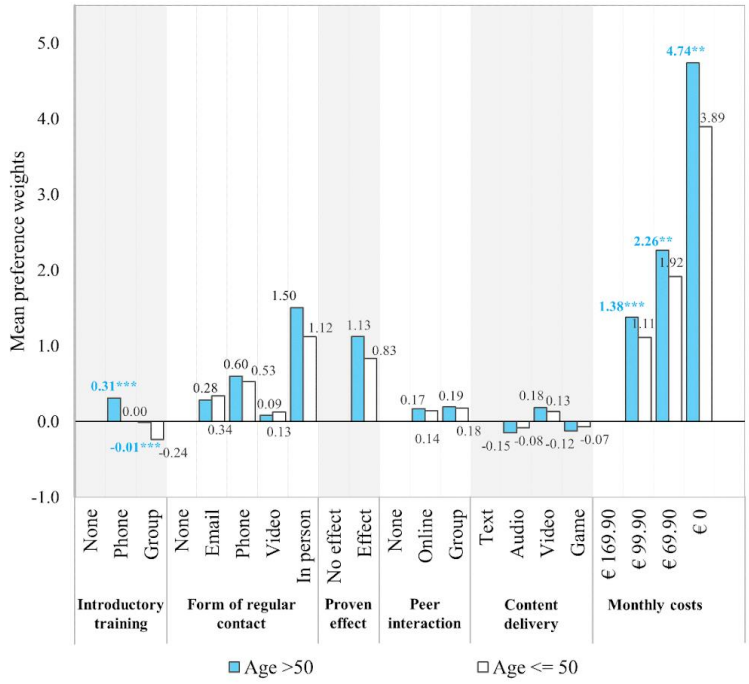


Gender:

Female (58.3%)

Male (41.7%)

Fig. B3: Age

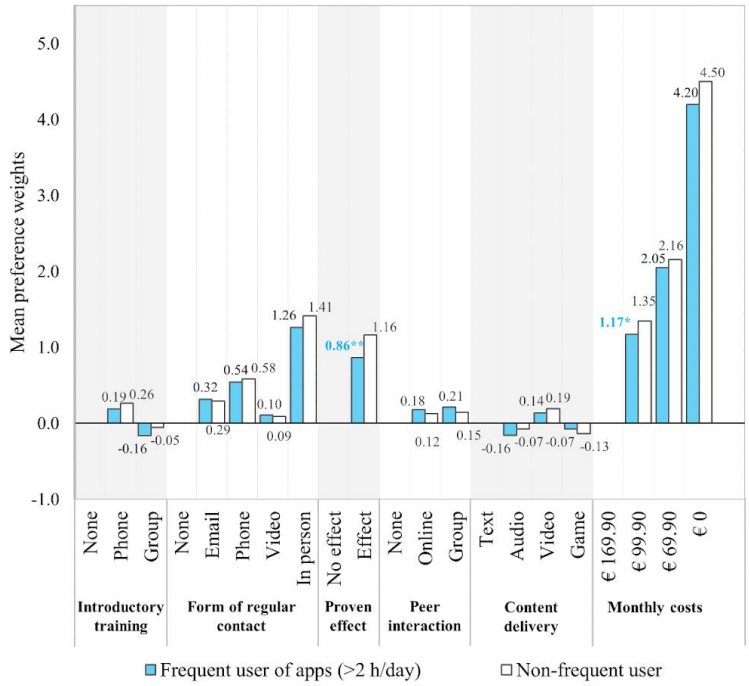


Application use: How many hours are you using programs/applications on your electronic devices per day?

Age > 50 (55.7%)

Age <= 50 (44.3%)

Fig. B4: Regular application users



Application use: How many hours are you using programs/applications on your electronic devices per day?

< 2 hours (44.6%)

>=2 hours (55.4%)

4 Preferences of psychotherapists for blended mental health interventions in Germany: a discrete choice experiment

4.1 Introduction

In light of the ongoing COVID-19 pandemic, calls for the use of digital technology in mental health have increased (1). Lockdowns have forced many therapists and patients to turn to videoconferencing as a substitution for face-to-face sessions and rekindled interest in e-mental health interventions, also called online- or web-based therapeutic interventions (eMHIs) (1). eMHIs are self-help-based, usually short-term therapeutic programs mainly based on cognitive behavior therapy (CBT) for patients with mild and moderate symptoms (2). eMHIs usually include some remote interaction with a psychologically skilled coach or therapist via e-mail, telephone or video conferencing (3). eMHIs have been found to be effective in improving mental health and treating psychological conditions, such as psychological distress, burnout, depression, anxiety, insomnia, eating disorders, or problematic substance use (2, 4, 5). Despite advantages for patients in terms of the flexible delivery of eMHIs, their adherence and acceptability among the general population remain limited compared to face-to-face psychotherapy (14-18). Studies on the acceptance barriers associated with eMHIs revealed a strong patient preference for personal contact in the therapy process (6, 7). Emerging blended care (BC) treatment formats combine the use of eMHIs and traditional face-to-face therapy, aiming to link the advantages of technology and personal contact with a therapist (8). According to current evidence, patients experience blended formats positively and seem to prefer BC to the standalone use of eMHIs (9-12). A strong preference for blended types of interventions was also confirmed in a recent study from Germany using a discrete choice experiment (DCE)

(12). Results along the same lines were found in a survey on attitudes towards digital treatment of depression in eight European countries[76] (10).

The first studies on attitudes towards eMHIs among mental health care providers, predominantly psychotherapists and psychologists, have shown similar tendencies; therapists prefer BC over the standalone use of eMHIs and associate BC with lower risks and disadvantages (11, 13-15). Attitudes towards BC vary depending on geographical location or therapeutic orientation. Therapists in countries with a higher level of dissemination of e-mental health, such as the Netherlands, Sweden and United Kingdom, express optimistic attitudes towards BC; by contrast, therapists in countries such as Austria and Germany, with lower e-mental health utilization, or France, with a strong tradition of psychodynamic therapies, emphasize disadvantages and risks regarding eMHIs and hesitation regarding future use (10, 14, 16). CBT-trained professionals are more optimistic about eMHIs and blended interventions in general than therapists with other therapeutic backgrounds (10, 13-15, 17).

In general, it is still unclear why psychotherapists are hesitant to use BC and under which conditions they would be ready to use eMHIs. One complicating factor in exploring attitudes towards BC is the lack of coherent understanding or definition of BC, which can be implemented in various forms (8, 18). The BC format depends on the type of online components used, the extent to which online and personal sessions are combined, and the chronological order in which the online component will be applied—before, parallel to or after personal therapy (8, 11, 18). Preferences for BC use may depend on the configuration of the BC format and application scenarios; however, no study has investigated the preferences of psychotherapists considering different BC application scenarios thus far.

[76] France, Germany, Netherlands, Poland, Spain, Sweden, Switzerland, and the United Kingdom

The aim of our study was two-fold. First, we wanted to explore previous experiences with and expectations for using BC and attitudes towards specific features of BC among psychotherapists in Germany, a country with low e-mental health utilization with an increasing need for timely and adequate psychotherapy (17). Second, given the low diffusion of BC and hesitation regarding eMHIs among German therapists (14, 17), we were interested in understanding psychotherapists' preferences regarding BC formats and application modes. Therefore, we conducted a DCE, which entails choices between hypothetical blended treatment options, thus making blended treatment more tangible to participants than is possible with conventional survey techniques. To our knowledge, this is the first DCE that explored preferences among psychotherapists regarding eMHIs or BC. Knowing which BC application scenarios are preferred by therapists can help policy makers and BC program developers to facilitate conditions and design BC formats that are more attractive to therapists, which could increase the acceptance and uptake of such techniques among different providers in in- and outpatient settings. With citizens and patients in Germany and elsewhere seemingly open to the use of BC (12), this could shift some parts of certain forms of mental health care to a digital format, thus freeing up therapeutic resources for other purposes.

4.2 Methods

We designed a survey with two distinct parts: The first part consisted of a series of questions on therapists' experiences with and expectations for BC, as well as their attitudes towards specific BC features. To develop these questions, we consulted the related literature, especially Dijksman et al. (2017), who examined the perception and needs of psychologists regarding BC in the Dutch context (16). We also conducted research to identify further BC online components and inquired about their relevance in exploratory interviews with five psychotherapists. The second part of our survey and study consisted of a DCE, which included four steps:

(1) defining attributes and levels for the experiment; (2) generating the experimental design and survey; (3) piloting the survey; and (4) collecting the data. The DCE design development followed best practice guidance, including consideration of the 10-point checklist for conjoint experimental design provided by the International Society for Pharmacoeconomics and Outcomes Research (ISPOR) (19).

4.2.1 Development of attributes and levels

Attributes and levels for the DCE were developed using a stepwise qualitative approach. First, we conducted a literature review on BC with a focus on therapists' perceptions of and barriers to the use of BC (11, 14-16). In the second step, we structured the identified factors that promote or hinder the use of blended treatment using the unified theory of acceptance and use of technology (UTAUT), formulated by Venkatesh (20). Venkatesh et al. defined four core determinants of users' behavioral intention to use a technology: performance expectancy, effort expectancy, social influence, and facilitating conditions (20). According to previous research, performance expectancy has the largest impact on the intention to use the technology (21). Tailoring this to the context of BC, we included the attribute *effectiveness* of the online component used in blended treatment in our DCE design. Effort expectancy refers to the perceived difficulty of using the technology. As effort expectancy highly depends on the type and form of online components being used, it was not included as an attribute. Social influence describes the degree to which individuals perceive that individuals or organizations whose opinions and views they appreciate believe that they should use a certain technology. Anticipating peer effects, we included social influence as the *recommendation* attribute, relating to both recommendations by colleagues and recommendations by professional society. Last, facilitating conditions are defined as organizational or technical conditions that encourage technology

use (20). We translated this determinant as a *reimbursement* attribute, which includes a financial incentive for therapists that could encourage the adoption of BC (22). Because an important adoption factor identified in previous research was the presence of a good therapeutic relationship, which depends on the concrete operationalization of the blended treatment—the number of face-to-face sessions and amount of independent work of the client with the online component—we included the attribute *ratio* of online and personal sessions in our design (11, 13, 14, 16). The levels corresponding to the attributes were chosen not only to reflect realistic scenarios but also to provide a spread enabling respondents to differentiate between levels. We conducted semistructured interviews with five therapists with different specializations (two CBT, one psychodynamic, two humanistically oriented psychotherapists) and refined our selection of attributes and levels. The final experimental design included five attributes with two to three levels each (see Table 4-1).

Table 4-1: Description of attributes and levels

Attribute	Level	Description
1) Recommendation	From a colleague; from a professional association; none	This feature refers to a recommendation that you received for the online component (tool or therapy program).
2) Proven effectiveness	9 out of 10 clients; 8 out of 10 clients; 7 out of 10 clients	This attribute describes the clinical effectiveness of the online component in comparison to no therapy based on the first studies, e.g., in the form "For 9 out of 10 clients, the online component (tool or program) was clinically effective". Since 100% effectiveness has not yet been proven, the following options can be chosen: 7 out of 10, 8 out of 10, and 9 out of 10 clients.
3) Time ratio of face-to-face and online sessions	20:80; 50:50; 80:20	This attribute relates to the time invested and describes the percentage (%) ratio in which personal sessions and an online component (tool or program) are combined in an individual therapy process for each client. Examples are 20:80, 50:50 or 80:20, where the first number reflects face-to-face sessions and the second reflects the client's independent work with an online component.

4) Reimbursement for the use of an online component	Proportional to time investment; proportional to time investment + lump sum	This attribute describes the reimbursement model for the use of BC: Proportional to the time invested for the online component per therapy block (preparation, follow-up work, supervision of homework, etc.) or rather proportional to the time invested for the application of an online component plus a lump sum.

4.2.2 Choice tasks and experimental design

We constructed the choice tasks using unlabeled, paired comparisons. We used a fractional factorial design to reduce the response burden for participants (23). A D-efficient Bayesian design was generated using JMP software from the SAS Institute. The design was optimized for main effects and all one-way interactions based on a conditional logit model. Attributes and levels were dummy coded, and Bayesian priors were obtained from a pretest. As the number of parameters to be estimated (main effects plus interaction effects) was larger than the maximum number of choice tasks we expected to still be feasible for respondents (16), the final design included 32 choice tasks that were divided into two blocks to guarantee response efficiency while facilitating robust statistical analysis. Participants were randomly allocated to one of the blocks of 16 choice tasks. An opt-out option was excluded in order to increase the amount of information collected and avoid interpretation bias (24).

4.2.3 Survey design

The survey itself started by informing respondents about the definition of BC and the aim of the study. In addition to collecting sociodemographic information, the first part of the survey consisted of questions on attitudes towards and previous experience with eMHIs, as well as preferences for individual components of eMHIs, such as videoconferencing or CBT-based exercises. The second part started by familiarizing respondents with the DCE elicitation format and the types of questions that would be asked, followed by an unrelated warm-up choice task. Next, all attributes and levels of the DCE were explained in a narrative fashion before

respondents had to answer the 16 choice tasks. Following the DCE, participants were asked about their general views of the advantages and disadvantages regarding BC and asked to evaluate the difficulty of DCE and the survey in general.

Study pilot

A pretest of the DCE was conducted among 30 therapists from the same respondent pool as in the main data collection. Data from the pretest were used to refine the questionnaire part of the survey, i.e., reducing the response burden (25) and to obtain the priors of the Bayesian D-efficient design.

4.2.4 Data collection

We administered the survey online through a market research agency specializing in health care providers (DocCheck Community GmBH) to individuals who, at that time, were working as psychotherapists in Germany. Data collection occurred in August 2020. A sample of 200 respondents was targeted to provide sufficient statistical power for the DCE based on a rule-of-thumb calculation proposed by Johnson and Orme (26). We collected explicit and informed consent from respondents after providing them with a detailed explanation of how their personal data would be used. The participants received small monetary compensation from the market research agency.

4.2.5 Statistical analysis

Discrete choice data are commonly analyzed based on the random-utility framework (27) by applying different statistical models, which must be selected to fit the purpose of the study (28, 29). In our case, attempting to elicit preferences for BC interventions among psychotherapists, who constitute a heterogeneous group concerning treatment styles or therapeutic focus,

we expected a large variety of preferences. Therefore, to specifically model preference heterogeneity while also relaxing the independence of irrelevant alternative assumptions, a mixed logit model was estimated (30). To select the utility function, the following steps were taken: First, we tested whether the inclusion of an alternative specific constant (ASC) and the inclusion of block dummy variables, indicating the survey version, would be necessary to obtain unbiased estimates based on a main effects mixed logit model (28). Second, different functional forms of the effectiveness and face-to-face online ratio attributes were specified, namely, linear and logarithmic instead of categorical. Third, we tested several two-way interactions between attributes suspected to be correlated. Categorical variables were dummy coded throughout the analysis. In the final mixed logit model, 500 Halton draws were specified, all parameters for which we found heterogeneity were set to be random and normally distributed, and individual-level clustered standard errors were used. Marginal effects were calculated using the *mixlpred* command.

To investigate whether preferences specifically differed for various subgroups, interaction terms of the respective subgroup indicators (e.g., therapeutic style, clinic or outpatient, potential user of BC, previous user of BC, age, gender) and the main effects parameters were included in separate models. The significance of the difference in parameter estimates between subgroups was tested using χ^2 tests for joint significance. We conducted two proposed tests to assess the internal validity of the choice experiment data (31). First, using the *respdiff* command, we investigated the extent to which straight lining occurred, i.e., respondents always choosing either option A or option B, indicating a lack of serious engagement with the experiment. Second, attribute dominance, relating to noncompensatory preferences, was examined by calculating lexicography scores and counting the proportion of choices based on one attribute. We assumed attribute dominance if the lexicographic score was above 90%, as suggested

previously (32). All calculations were conducted using Stata 16 (StataCorp, College Station, TX).

4.3 Results

4.3.1 Respondent characteristics

The survey reached 1335 psychotherapists via e-mail who were members of the DocCheck Panel. A total of 238 respondents started the survey, 38 did not complete the questionnaire, and only three dropouts occurred after starting the DCE part of the survey. Table 4-2 shows the respondent characteristics as well as their experiences and expectations regarding BC formats. The age and gender distribution in the sample was similar to what has been reported for the overall population of psychotherapists in Germany (49%), while our sample likely was slightly younger (33). We observed a realistic spread of therapeutic orientations across the main therapeutic approaches, although systemic and humanistic approaches were likely underrepresented[77] (34). Almost all respondents were medical psychotherapists practicing in inpatient facilities, while one-third worked predominantly in outpatient care.

Table 4-2: Sample characteristics and experiences with and expectations for BC

Respondent characteristics (n=200)		**Experiences and expectations regarding BC**	
Mean age in years	48	***Experience with BC format in therapy***	
Female	43%	Yes	26.5%
Therapeutic orientation		No	73.5%
Behavioral	52.5%	***Evaluation of previous experience with BC***	
Psychodynamic or analytic	39%	Excellent	7.5%
Behavioral and psychodynamic or analytic	3%	Satisfied	54.7%
Systemic	1%	Neither good nor bad	32.1%
Humanistic	0.5%	Bad	5.7%
Another	4%	Very bad	0%
Professional background		***Willing to use BC in the future***	
Psychological psychotherapist	1.5%	Yes	90.5%
Medical psychotherapist	89%	No	8.5%
Child and adolescent psychotherapist	1%	***Preferred timing of BC application***	

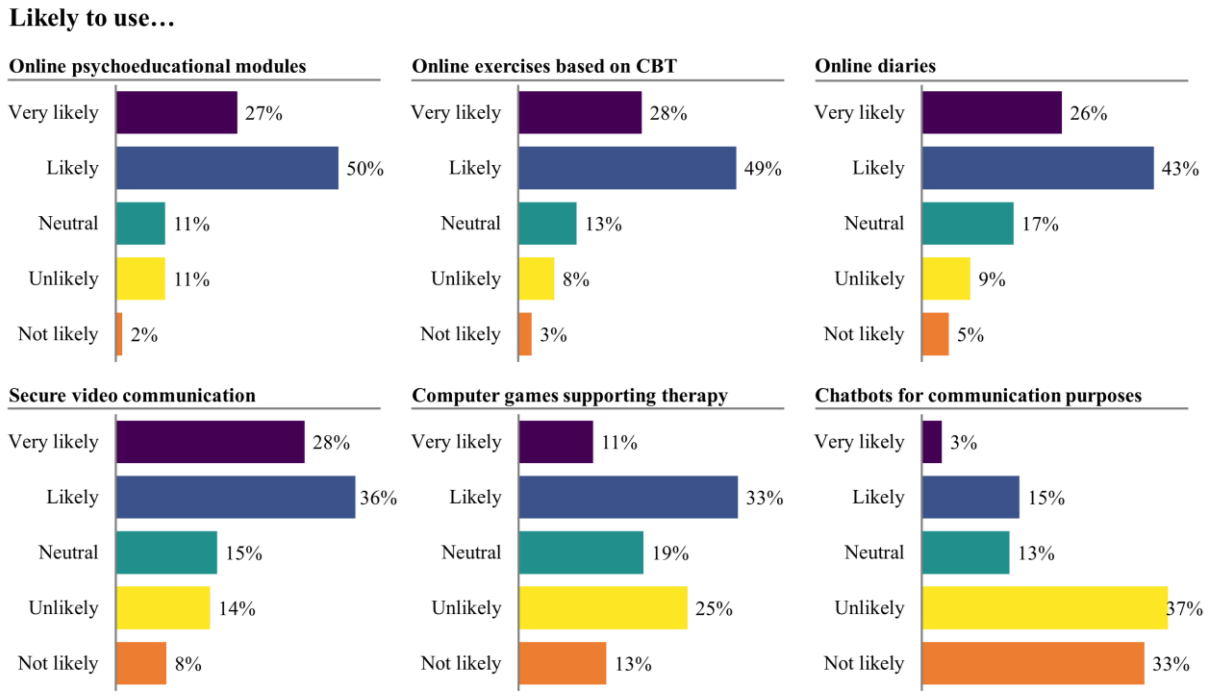
[77] As psychoanalysis, psychodynamic therapy, and cognitive behavioral therapy meet the requirements of German health insurance companies, mental health professionals usually opt for one of these three specializations in their postgraduate training.

Alternative practitioner for psychotherapy	0%	Stepped care before in-person treatment	9%
Psychiatrist	3.5%	Integrated parallel BC	68.5%
Psychiatrist and psychotherapist	3.5%	After in-person treatment	22.5%
General practitioner	1%	***Perceived main advantage of BC***	
Neurologist	0.5%	Time savings for therapists and patients	22.2%
Main place of work		Patient empowerment	21.3%
Own outpatient practice	33%	Increase in treatment efficacy	15%
Clinic/hospital	55%	Flexibility for therapists and patients	7.5%
Other	12%	Larger patient group can be reached	6.7%
Satisfaction with monthly income		Bridging waiting times for therapy	4.6%
Highly satisfied	8%	***Perceived main risk of BC***	
Satisfied	60.5%	Lack of personal support for patient	26.1%
Neither satisfied nor dissatisfied	20%	Deterioration of therapeutic alliance	17.4%
Dissatisfied	10%	Misinterpretation and treatment errors	23.1%
Very dissatisfied	1.5%	Overburdening patient compliance	9.3%
		Privacy risks	7.7%
		Low level of customization	6.7%
		Lack of therapeutic effectiveness	5.6%

4.3.2 Experiences with and expectations for BC

Most respondents who had used BC before (26.5%) evaluated their experiences as positive (Table 4-2). Psychotherapists seemed willing to use BC in the future, mainly by integrating BC into regular therapy. The main reported reasons for not opting for BC in the future were the “too impersonal” character of treatment (55.6%), doubts regarding their effectiveness (11.1%), lack of compatibility with the performed therapy form (11.1%), and a lack of interest or need (5.6%). Time savings and patient empowerment were mentioned most often as potential advantages of BC, whereas lack of personal support and deterioration in the therapeutic alliance were seen as main risks. However, most respondents rated the likely impact of BC on the therapeutic alliance as positive (47.5%) or neutral (45.5%). The BC features most likely to be used in the future (Figure 4-1) were psychoeducation, online exercises, online diaries, and secure video communication, while chatbots for communication were least likely to be used.

Figure 4-1: Likelihood of using BC features



4.3.3 Discrete choice experiment results

The small drop-out rate during the DCE (3 out of 203) and the type of qualitative comments collected on the overall survey indicated that the respondents were able to understand the choice tasks. Tests for the internal validity of the experimental data showed that straight lining occurred in four instances (2% of the sample), and noncompensatory behavior, with a lexicographic score of over 90%, was observed in 16% of the sample. These values lie close to the respective medians that were reported for these tests in a study summarizing 55 choice experiments (31). In addition, 30 of these 32 observations exhibit dominant choice behavior for the ratio of online and personal sessions attribute. It is conceivable that for some psychotherapists, this attribute is indeed dominant and that noncompensatory behavior thus does not (always) imply decision heuristics.

The estimated utility function included an ASC and block-specific dummy variables to account for potential bias due to the positioning of the alternatives and the allocated survey version. Linear specifications of the effectiveness and face-to-face vs. online attributes were selected since the assumption of linear preferences regarding these two variables could not be rejected in models estimated only with categorical variables (χ^2=0.02, p=0.89 and χ^2=1.46, p=0.23, respectively). We tested the inclusion of two-way interactions between the additional reimbursement attribute and both the face-to-face vs. online attribute and the effectiveness attribute. Both were nonsignificant and therefore excluded in the final model. Testing the inclusion of an interaction between the effectiveness and face-to-face vs. online attributes did yield a significant coefficient, but the signs and sizes of both attribute coefficients became negative and nonsignificant. Therefore, for ease of interpretation, we refrained from including the interaction in the final model.

Table 4-3 contains the results of the mixed logit model. All main effects coefficients were significantly different from zero (columns 2 and 3), indicating their importance in the choice context. The signs of the attribute levels pointed in the expected direction, and the order of the recommendation attribute levels was logical (i.e., higher preference for recommendation by society than by colleagues), providing some confidence in the theoretical validity of the results. The recommendation by professional societies to use a certain BC intervention was the most important attribute level, while additional reimbursement played a minor role. Greater effectiveness and a higher face-to-face ratio of the BC intervention increased the likelihood of selecting this intervention. Preference heterogeneity was found for all included attributes, as indicated by the significant standard deviations of the parameters (columns 4 and 5). The marginal effects in column 6 demonstrate the change in likelihood of choosing a certain BC intervention if the attribute level changes compared to the reference category (or a unit change for linear variables), conditioning on all other attributes remaining constant. This also allows for a

straightforward interpretation of the relative magnitude of the coefficients. Compared to no recommendation, a recommendation by a professional society increases the conditional likelihood of selecting a BC intervention by 25.7%. Using the effectiveness levels from the DCE, a change in effectiveness from 7 out of 10 to 9 out of 10 increased the choice likelihood by a slightly lower factor (21.0%). The smallest marginal effect was found for the reimbursement attribute (9.5%).

Table 4-3: DCE results based on a mixed logit model

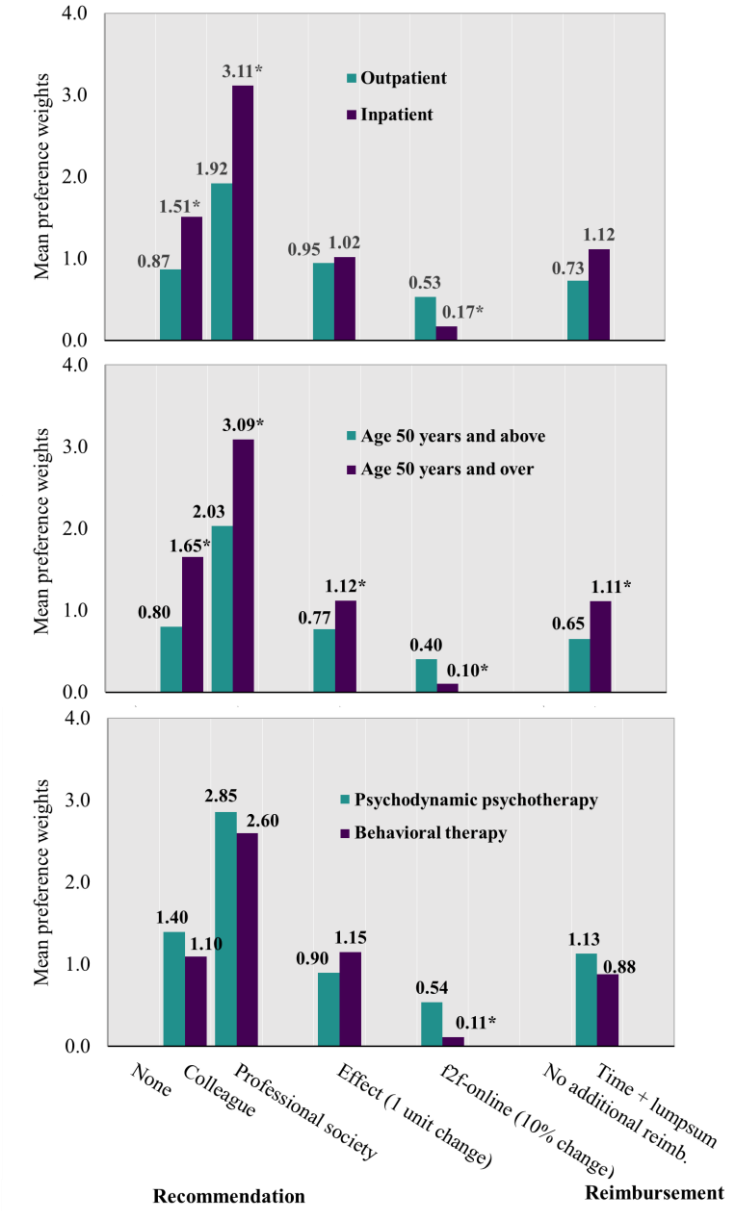
	Preference estimates				Marginal effect
Attributes and levels	**Coefficient**	**95% CI**	**SD**	**95% CI of SD**	
Recommendation					
None	Reference				Reference
Colleagues	1.30	[0.94,1.65]	1.46	[0.97,1.96]	12.2%
Professional societies	2.70	[2.12,3.27]	2.45	[1.78,3.11]	25.7%
Effectiveness (linear)	1.08	[0.85,1.30]	1.02	[0.73,1.30]	
8 of 10 vs. 7 of 10					10.7%
9 of 10 vs. 7 of 10					21.0%
Face to face vs. online	0.03	[0.01,0.04]	0.09	[0.07,0.11]	
50:50 vs. 20:80					7.4%
80:20 vs. 20:80					14.2%
Reimbursement					
Proportional to time	Reference				Reference
Time + lump sum	0.95	[0.66,1.23]	1.33	[1.02,1.63]	9.5%
ASC	-0.32	[-1.33,0.69]	1.37	[0.59,2.15]	
ASC x block2	0.05	[-0.97,1.08]	1.39	[0.51,2.27]	
ASC x block3	0.29	[-0.70,1.29]	1.63	[0.58,2.67]	
Log likelihood	-1,568				
AIC	3,223				
BIC	3,521				
Respondents	200				
Observations	6,400				

Note. Attributes were dummy coded. Coefficients refer to the mean preference estimates and standard deviations (SD) of the distribution around the means. Uncertainty around the mean and SDs is shown using 95% confidence intervals (CIs).

In terms of the subgroups, we found significantly different coefficient estimates for psychotherapists working in the inpatient vs. outpatient setting (χ^2=15.70, p<0.01), for respondents

being younger or older than 50 years (χ^2=17.07, p<0.01), and for therapists predominantly practicing behavioral therapy vs. psychodynamic psychotherapy (χ^2=16.62, p<0.01). Figure 2 presents the coefficient estimates for the respective subgroups. Younger therapists put more weight on recommendations to use a BC format, the potential effectiveness of the intervention and additional reimbursement, while a higher share of face-to-face vs. online time was less important to them. Inpatient therapists are more influenced by recommendations than are outpatient therapists, who preferred a higher share of face-to-face vs. online time. Face-to-face time was significantly less important for therapists predominantly conducting behavioral therapy than for therapists conducting psychodynamic psychotherapy.

Figure 4-2: Subgroup results for age, outpatient vs. inpatient setting, and type of therapy



Note. *Interaction term significant at the 10% level. Abbreviation: f2f-online, ratio of face-to-face vs. online time.

4.4 Discussion

Conducting a survey, including a DCE, with a sample of 200 psychotherapists from Germany, our study assessed psychotherapists' experiences, expectations and preferences regarding BC psychotherapy formats, which combine the application of eMHIs and regular psychotherapy. The study's main contributions are as follows. First, to our knowledge, this is the first DCE

exploring preferences among psychotherapists for eMHIs or BC. Second, our survey described and distinguished among concrete BC features and application scenarios, making our analysis as tangible as possible for psychotherapists. Third, this study is the first survey, and DCE, that has investigated preferences for BC in the context of Germany, an example of a country with low e-mental health utilization.

In general, we found rather positive attitudes towards BC among German psychotherapists and a strong willingness to use BC in the future. This finding was surprising, as previous studies on the attitudes of German-speaking psychotherapists towards eMHIs and BC indicated that they had reservations (14, 17), but is in concordance with the more optimistic attitudes of Dutch therapists (11, 15, 16). Most therapists prefer using BC features such as psychoeducation, online exercises, online diaries, and secure video communication integrated into regular therapeutic cycles instead of pre- or post-therapy applications. Similar results were found in a Delphi study in which Dutch therapists found practical therapy components such as assignments, diaries and psychoeducation most suitable for a digital format (11). This preference was also found in other studies among therapists from the Netherlands and Austria (14, 16). Most respondents perceived a positive or neutral impact of BC on the therapeutic relationship. It is not surprising that therapists conducting psychodynamic therapy are less likely to use BC treatments with a large online component than behavioral therapists, as BC is mainly grounded in CBT, which was also found in other studies (13-15, 17). The main reasons for not applying BC were lack of personal contact, doubts regarding effectiveness and lack of personal interest. These findings are in concordance with previous research across different countries, where fears of losing contact with patients, not offering patients the amount of help they need, or making treatment mistakes were frequently expressed (14-16, 18). A previous choice experiment from Germany among the general population also showed that accompanying in-

person contact is perceived as a central need when using eMHIs (12). The main stated advantages of BC among therapists coincide with the first findings referring to patient empowerment, patient training in self-management skills, and the perception of increased treatment effectiveness, which was also shown in other studies (35). The preference results showed that a recommendation to use a BC treatment format made by a professional society (psychotherapist association) was most influential when choosing between the treatment scenarios in the choice experiment. The effect was even larger among therapists working in an inpatient setting. While greater effectiveness and a larger share of face-to-face vs. online time were important as well, additional reimbursement for BC was less decisive, especially among older providers. The financial dimension apparently did not play a significant role among German therapists, which is surprising because in previous research, the primary incentive for using eMHIs among mental health stakeholders was the expected cost-effectiveness (10, 36).

4.5 Limitations

Although our study was carefully designed and tests for internal validity revealed satisfactory results, we need to acknowledge the following research limitations related to the external validity of our findings. In Germany, both qualified psychologists *and* physicians (including psychiatrists), who have completed several years of specialist practical training and certification in psychotherapy, are authorized to practice psychotherapy (34). While providing us direct access to a sufficiently large pool of psychotherapists, the selected sampling agency (DocCheck) has a drawback in that most of the panel's members have a medical background, resulting in our sample mainly consisting of physicians with psychotherapeutic training (89%). The share of medical psychotherapists among office-based Statutory Health Insurance psychotherapists was 24% in 2017 (37). However, this represents only one portion of all ambulatory psychotherapy providers. This share is likely to be higher in outpatient departments

of psychiatric and psychosomatic facilities, which also provide ambulatory psychotherapy and are likely users of eMHIs. However, data about the educational background of all therapists providing ambulatory psychotherapy in Germany are not available. Thus, we estimate that the share of medical psychotherapists among all therapists providing ambulatory psychotherapy in Germany is lower in the total population than in our sample.

A further limitation relates to the selected characteristics in the choice experiment. While these were carefully selected using standard practices, including interviews with providers, the experimental design could have omitted important characteristics, in part because no choice experiments have been conducted in this novel but emerging research area. That BC treatment formats are also new to many psychotherapists, who often have little to no prior experience, may also be seen as a limitation. While the DCE allows us to present hypothetical scenarios, the structure, mechanism, and potential benefits/risks of BC thus remained quite abstract to respondents.

4.6 Conclusions

German medical psychotherapists, despite having little previous experience with BC, showed positive attitudes towards BC together with a strong intention for future use in treatments. Similar to therapists from other countries, they appreciate the use of eMHIs for practical CBT-oriented therapy tasks while stressing the importance of maintenance of the therapeutic relationship through the larger number of parallel face-to-face sessions. Our findings from the DCE suggest a strong preference for BC treatment that includes an online component approved by a professional psychotherapist society. This highlights the importance of including professional associations early in the development, application, and evaluation of BC treatments to encourage uptake. Our results suggest that German psychotherapists care less about the additional reimbursement but are ready to use BC formats if they are convinced of the effectiveness and

trustworthiness of the online components. Thus, financial incentives may not be very useful for encouraging wider use of BC in Germany, and assessment along with recommendations from trusted institutions for online components of BC would be recommended.

4.7 References

1. Wind TR, Rijkeboer M, Andersson G, et al. The COVID-19 pandemic: The 'black swan' for mental health care and a turning point for e-health. *Internet Interv*. 2020; 20: 100317.
2. Christensen H, Hickie IB. Using e-health applications to deliver new mental health services. *Med J Aust.* 2010; 192.
3. Barak A, Klein B, Proudfoot JG. Defining internet-supported therapeutic interventions. *Ann Behav Med.* 2009; 38: 4-17.
4. Barak A, Hen L, Boniel-Nissim M, et al. A Comprehensive Review and a Meta-Analysis of the Effectiveness of Internet-Based Psychotherapeutic Interventions. *J Technol Hum Serv.* 2008; 26: 109-60.
5. Grist R, Cavanagh K. Computerised Cognitive Behavioural Therapy for Common Mental Health Disorders, What Works, for Whom Under What Circumstances? A Systematic Review and Meta-analysis. *J Contemp Psychother.* 2013; 43: 243-51.
6. Musiat P, Goldstone P, Tarrier N. Understanding the acceptability of e-mental health--attitudes and expectations towards computerised self-help treatments for mental health problems. *BMC Psychiatry.* 2014; 14: 109.
7. Renn BN, Hoeft TJ, Lee HS, et al. Preference for in-person psychotherapy versus digital psychotherapy options for depression: survey of adults in the U.S. *NPJ Digit Med.* 2019; 2: 6.
8. Wentzel J, van der Vaart R, Bohlmeijer ET, et al. Mixing Online and Face-to-Face Therapy: How to Benefit From Blended Care in Mental Health Care. *JMIR Ment Health.* 2016; 3: e9.
9. Etzelmueller A, Radkovsky A, Hannig W, et al. Patient's experience with blended video- and internet based cognitive behavioural therapy service in routine care. *Internet Interv.* 2018; 12: 165-75.
10. Topooco N, Riper H, Araya R, et al. Attitudes towards digital treatment for depression: A European stakeholder survey. *Internet Interv.* 2017; 8: 1-9.
11. van der Vaart R, Witting M, Riper H, et al. Blending online therapy into regular face-to-face therapy for depression: content, ratio and preconditions according to patients and therapists using a Delphi study. *BMC Psychiatry.* 2014; 14.
12. Phillips E, Himmler S, Schreyögg J. Preferences for e-mental health interventions in Germany: a discrete choice experiment. *Value Health* 2021 (forthcoming).

13. Schuster R, Leitner I, Carlbring P, et al. Exploring blended group interventions for depression: Randomised controlled feasibility study of a blended computer- and multimedia-supported psychoeducational group intervention for adults with depressive symptoms. *Internet Interv.* 2017; 8: 63-71.

14. Schuster R, Pokorny R, Berger T, et al. The Advantages and Disadvantages of Online and Blended Therapy: Survey Study Amongst Licensed Psychotherapists in Austria. *J Med Internet Res.* 2018; 20: e11007.

15. Mol M, van Genugten C, Dozeman E, et al. Why Uptake of Blended Internet-Based Interventions for Depression Is Challenging: A Qualitative Study on Therapists' Perspectives. *J Clin Med.* 2020; 9.

16. Dijksman I, Dinant GJ, Spigt M. The Perception and Needs of Psychologists Toward Blended Care. *Telemed J E Health.* 2017; 23: 983-95.

17. Schröder J, Berger T, Meyer B, et al. Attitudes Towards Internet Interventions Among Psychotherapists and Individuals with Mild to Moderate Depression Symptoms. *Cognit Ther Res.* 2017; 41: 745-56.

18. Erbe D, Eichert HC, Riper H, et al. Blending Face-to-Face and Internet-Based Interventions for the Treatment of Mental Disorders in Adults: Systematic Review. *J Med Internet Res.* 2017; 19: e306.

19. Bridges JF, Hauber AB, Marshall D, et al. Conjoint analysis applications in health--a checklist: a report of the ISPOR Good Research Practices for Conjoint Analysis Task Force. *Value Health.* 2011; 14: 403-13.

20. Venkatesh V, Morris MG, Davis GB, et al. User acceptance of information technology: Toward a unified view. *Mis Q.* 2003; 27: 425-78.

21. Dulle FW, Minishi-Majanja MK. The suitability of the Unified Theory of Acceptance and Use of Technology (UTAUT) model in open access adoption studies. *Inf Dev.* 2011; 27: 32-45.

22. Hennington A, Janz BD. Information Systems and Healthcare XVI: Physician Adoption of Electronic Medical Records: Applying the UTAUT Model in a Healthcare Context. *Commun Assoc Inf Syst.* 2007; 19.

23. Reed Johnson F, Lancsar E, Marshall D, et al. Constructing experimental designs for discrete-choice experiments: report of the ISPOR Conjoint Analysis Experimental Design Good Research Practices Task Force. *Value Health.* 2013; 16: 3-13.

24. Campbell D, Erdem S. Including Opt-Out Options in Discrete Choice Experiments: Issues to Consider. *Patient.* 2019; 12: 1-14.

25. Rolstad S, Adler J, Ryden A. Response burden and questionnaire length: is shorter better? A review and meta-analysis. *Value Health.* 2011; 14: 1101-8.

26. Orme B. *Sample Size Issues for Conjoint Analysis Studies.* Sawtooth Software Research Paper Series. Sequim, Washington: Sawtooth Software Inc., 1998.

27. McFadden D. Economic theory and mathematical economics. In: Zarembka P, eds. *Frontiers in econometrics.* New York: Academic Press, 1974.

28. Lancsar E, Fiebig DG, Hole AR. Discrete Choice Experiments: A Guide to Model Specification, Estimation and Software. *PharmacoEconomics.* 2017; 35: 697-716.

29. Soekhai V, de Bekker-Grob EW, Ellis AR, et al. Discrete Choice Experiments in Health Economics: Past, Present and Future. *PharmacoEconomics.* 2019; 37: 201-26.

30. Hensher DAR, John M.; Greene, William H. *Applied Choice Analysis.* Cambridge Cambridge University Press, 2015.

31. Johnson FR, Yang JC, Reed SD. The Internal Validity of Discrete Choice Experiment Data: A Testing Tool for Quantitative Assessments. *Value Health.* 2019; 22: 157-60.

32. Krucien N, Watson V, Ryan M. Is Best-Worst Scaling Suitable for Health State Valuation? A Comparison with Discrete Choice Experiments. *Health Econ.* 2017; 26: e1-e16.

33. Bundesärztekammer. Ergebnisse der Ärztestatistik zum 31. Dezember 2019. https://www.bundesaerztekammer.de/fileadmin/user_upload/downloads/pdf-Ordner/Statistik2019/WEBStatistik_2019_k.pdf, 25 October 2020.

34. Melcop N, von Werder T, Sarubin N, et al. The Role of Psychotherapy in the German Health Care System: Training Requirements for Psychological Psychotherapists and Child and Adolescent Psychotherapists, Legal Aspects, and Health Care Implementation. *Clinical Psychology in Europe.* 2019; 1.

35. Mathiasen K, Andersen TE, Riper H, et al. Blended CBT versus face-to-face CBT: a randomised non-inferiority trial. *BMC Psychiatry.* 2016; 16: 432.

36. Andersson G, Cuijpers P, Carlbring P, et al. Guided Internet-based vs. face-to-face cognitive behavior therapy for psychiatric and somatic disorders: a systematic review and meta-analysis. *World Psychiatry*. 2014; 13: 288-95.

37. KBV. Statistische Informationen aus dem Bundesarztregister. https://www.kbv.de/media/sp/2017_12_31_BAR_Statistik.pdf, 25 October 2020.

5 Conclusion and outlook

The studies included in this dissertation address important research gaps regarding the effectiveness of occupational eMHIs and acceptance of eMHIs among users and providers providing new insights and implications for further research and practice in this area.

The aim of Chapter 1 was to investigate the effectiveness of occupational eMHIs and its variation across different mental health areas. Reviewing 50 studies and conducting metanalysis for 34 studies, we found moderate effects on stress, insomnia, and burnout and small treatment effects of eMHIs on depression, anxiety, wellbeing, and mindfulness. Our results suggest that eMHIs can significantly improve mental health in an occupational context with small to moderate treatment effects varying on the mental health area being addressed. There are several implications for further research and practice that can be drawn from our study. Firstly, eMHIs addressing stress, insomnia, and burnout achieved higher treatments effects than eMHIs with the focus on mental health areas that are closer to a clinical condition like depression, for example. This fact could be explained with less stigmatization and more public acceptance of these mental health areas compared to others. This finding could be an important practical implication for interventions conducted directly in the workplace, and our hypothesis needs to be explored in further research. In concordance with previous research, we found an enhancing role of the higher age of participants on a treatment effect. However, this finding should be interpreted with caution, as RCTs with younger participants in an occupational context are rare. Thus, our second recommendation for future research is to reach young employees to address this research gap. The total population of our analysis included 15 258 participants; most of the participants (68.7%) were highly educated with at least some years of university education. There is a lack of studies addressing participants with lower educational levels. Therefore, we recommend testing the effectiveness of eMHIs in less knowledge-based occupational sectors. Fourthly, from the point of view of study design, our

results suggest that open community recruitment enhances the treatment effect. As an implication for practitioners conducting eMHIs directly at the workplace, we recommend taking advantage of open community recruitment settings, by providing maximum data security and anonymity as well as free time resources for engagement in the interventions. Finally, from a methodological point of view, we recommend testing the effectiveness of eMHIs also using objective outcomes such as biological markers so outcome assessment bias can be avoided, and the evidence in this field increased.

The aim of Chapter 2 was to investigate attitudes and preferences towards eMHIs in the German population combining the conventional survey techniques with DCE. To our knowledge, the study presented in Chapter 2 is the first DCE that has investigated preferences for different components of eMHIs in the German population. A total of 1984 respondents completed the survey. Using mixed logit models, we found that participants highly valued personal contact with a psychotherapist in blended care, proven effectiveness, and low price. In particular, our results stress the importance of the personal contact applying eMHIs and suggest a strong preference for blended care format - a combination of eMHIs and regular face-to-face sessions with a psychotherapist. This preference remained stable irrespective of sociodemographics, previous experience of psychotherapy, distress level, and the two context scenarios – application in prevention case vs depression - used in our DCE. Our results imply that the unfavourable perception of such eMHIs reflects more a wish for personal contact than a lack of trust in the effectiveness of such interventions. Furthermore, participants with previous experience of psychotherapy put greater emphasis on having regular contact of any form during online therapy with a person trained in psychology. Thus, the main practical implication from Chapter 2 on acceptance of eMHIs in the case of Germany as a country with low utilisation level of eMHIs would lie in the promotion and higher dissemination of blended care format that includes face-to-face contact with a psychotherapist. Secondly, as personal contact as

part of therapeutic relationship was of the main importance for participants, for future research we would recommend to investigate under which conditions a meaningful therapeutic relationship can be established via information and communication technologies or in particular in the context of blended care. Thirdly, our results suggest that the evidence on the effectiveness of eMHIs is another important impact factor of people's attitudes towards such interventions. This highlights the need for scientific support and monitoring during the development and roll-out of such programs in order to achieve higher acceptance and uptake in the general population. Finally, our results indicate that people in Germany are not willing to spend considerable amounts out of pocket for eMHIs, implying that services asking prices similar to those in our experiment are too expensive. Further research recommended investigating developments in the field of eMHIs in Germany now that digital health apps can be prescribed by providers and reimbursed by statutory health insurers.

The study presented in Chapter 3 aimed to investigate attitudes and preferences of licensed psychotherapists on BC in Germany combining the conventional survey techniques with DCE. Our results showed that German psychotherapists, although having little previous experience with BC, demonstrate positive attitudes towards BC together with the high intention for potential future use. This attitude remained stable across different psychotherapeutic orientations of the therapists. Similar to therapists from other countries, German therapists appreciate the use of eMHIs for practical CBT-oriented therapy tasks while stressing the importance of maintaining the therapeutic relationship through the larger amount of parallel face-to-face sessions. Our findings from the DCE suggest a strong preference for BC treatment that includes an online component that has been approved by a professional psychotherapist society. This result highlights the importance of including the professional associations early in the development, training, and evaluation of BC treatments, to foster their acceptance and uptake. Our results suggest that German psychotherapists care less about the additional reimbursement but are ready to use BC formats if they are convinced of the effectiveness and trustworthiness of

the online components. This indicates that financial incentives may not be very useful for encouraging wider use of BC in Germany while an assessment along with a recommendation from trusted institutions for online components of BC would be recommended.

The studies presented in this dissertation have made significant contributions to the field of occupational e-mental health shedding light on the effectiveness of eMHIs in the working context as well as providing distinctive insights into the application preferences of users and providers as well as their acceptance towards eMHIs. In the end, it is important to stress that new technologies as represented in this dissertation by eMHIs have the potential to shape and uniquely change our lives. It is our responsibility as researchers to critically observe these impacts and influences in our societies and disseminate our insights into practice revealing potentials and risks of emerging technologies especially in such a crucial for our sustainable prosperity and sensitive field as mental health.

6 A summary of studies

Chapter 1 "Effectiveness of occupational e-mental health interventions: a systematic review and meta-analysis of randomized controlled trials."

This systematic review and meta-analysis investigated the effectiveness of occupational eMHIs aimed at stress, depression, anxiety, burnout, insomnia, mindfulness, well-being, and alcohol misuse and their potential treatment moderators. We systematically reviewed randomized control trials published in English using three electronic databases (MEDLINE, PsycINFO, CINAHL) and three register trials. A pooled effect size for each mental health area was calculated using random-effects modelling. For each meta-analysis, we conducted an analysis of potential moderators (i.e., type of recruitment, age, gender, initial psychological symptoms, guidance, therapy type, and study quality). In total, 50 studies were included in the systematic review, and 34 studies were included in the meta-analyses. We noted moderate treatment effects on stress (Hedges' g =0.54), insomnia (g=0.70), and burnout (g=0.51) and small treatment effects on depression (g=0.30), anxiety (g=0.34), well-being (g=0.35), and mindfulness (g=0.42). The pooled effect on alcohol intake was small and nonsignificant. Our results suggest that occupational e-mental health interventions are associated with significant mental health improvements depending on mental health area. Higher moderate treatment effects were achieved for stress, insomnia, and burnout. These findings could potentially be explained by the lower degree of stigmatization linked to stress, sleep problems, or burnout than the stigmatization linked to mental health conditions that are closer to a clinical diagnosis of mental health disorder, such as depression, anxiety and alcoholism. However, more research is required to understand which factors contribute to the variation in the effectiveness of particular interventions depending on the mental health area and characteristics of participants and interventions.

Chapter 2 "Preferences for e-mental health interventions in Germany: a discrete choice experiment."

Recent evidence suggests that e-mental health interventions (eMHIs) can be effective at improving mental health but that there is still a notable hesitation among patients to use them. Previous research has revealed that patients perceive them as being less helpful than face-to-face psychotherapy. The reasons for this unfavourable perception are, however, not yet well understood. Our study aimed to address this question by eliciting preferences for individual components of eMHIs in a discrete choice experiment (DCE). Using a stepwise qualitative approach, we developed the following five attributes of eMHIs: "introductory training", "human contact", "peer support", "proven effectiveness", "content delivery", and "price". Additionally, we asked questions about respondents' demographics, attitudes, and previous experience of traditional psychotherapy, as well as their distress level. A total of 1984 respondents completed the survey. Using mixed logit models, we found that participants highly valued personal contact with a psychotherapist in blended care, proven effectiveness, and low price. Participants were indifferent towards the mode of content delivery but showed a slight preference for introductory training via phone, as well as for peer support via online forum alongside coach-led group meetings on site. Our results suggest a clear preference for blended care that includes face-to-face contact with a psychotherapist. This preference remained stable irrespective of sociodemographics, previous experience of psychotherapy, distress level, and the two context scenarios used in our DCE. Further investigations looking at the potential benefits and risks of blended care are needed.

Chapter 3 "Preferences of psychotherapists for blended mental health interventions in Germany: a discrete choice experiment."

Digital treatment formats are emerging within mental health care. Evidence suggests that recipients and providers of mental health care prefer a combination of digital and traditional elements within psychotherapy treatment formats, also called blended care (BC) over standalone digital formats. We examined the attitudes and preferences of licensed psychotherapists in Germany towards such BC applications. We fielded a survey among psychotherapists, including questions about attitudes, previous experiences, and expectations towards BC, as well as a discrete choice experiment. Attributes for the experiment were developed using a stepwise qualitative approach. A Bayesian D-efficient design was used to generate the choice tasks. The choice data were analysed, applying mixed logit models. Two hundred psychotherapists completed the survey. The attitude towards BC was mainly positive, with a highly reported intention to use BC formats. In the choice experiment, we found that recommendation from a professional society for a BC online component was the most important characteristic. Higher effectiveness and a larger share of face-to-face vs online time were also desired features, while a financial incentive to use BC was less relevant. Our results provide insights concerning the development and adoption of BC formats. Finding that a recommendation by a professional society is the most influential characteristics highlights the importance of including the professional associations early in the development and evaluation of BC formats. Furthermore, our results imply that financial incentive may not be effective for encouraging wider adoption of BC.

Kurzzusammenfassung der Studien

Kapitel 1 "Effektivität von betrieblichen E-Mental Health-Interventionen: ein systematisches Review und eine Metaanalyse von randomisierten kontrollierten Studien.

Im Rahmen dieses systematischen Reviews und der Metaanalyse wurde die Wirksamkeit betrieblicher E-Mental Health-Interventionen (eMHI), die auf Stress, Depressionen, Angststörungen, Burnout, Schlaflosigkeit, Achtsamkeit, Wohlbefinden und Alkoholmissbrauch gerichtet sind, sowie deren potenzielle Behandlungsmoderatoren untersucht. Wir überprüften systematisch randomisierte Kontrollstudien, die in englischer Sprache veröffentlicht wurden, aus drei elektronischen Datenbanken (MEDLINE, PsycINFO, CINAHL) und drei Registern für klinische Studien. Unter Verwendung einer Zufallseffektmodellierung wurde für jeden Bereich der psychischen Gesundheit eine aggregierte Effektgröße berechnet. Für jede Metaanalyse führten wir eine Analyse potenzieller Moderatoren durch (insb. Art der Rekrutierung, Alter, Geschlecht, anfängliche psychische Symptome, Kontaktart, Therapieart und Studienqualität). Insgesamt wurden 50 Studien in das systematische Review und 34 Studien in die Metaanalysen inkludiert. Wir haben moderate Behandlungseffekte festgestellt bezogen auf Stress (Hedges' g = 0,54), Schlaflosigkeit (g = 0,70) und Burnout (g = 0,51) sowie geringe Behandlungseffekte bezogen auf Depressionen (g = 0,30), Angststörungen (g = 0,34), allgemeines Wohlbefinden (g = 0,35) und Achtsamkeit (g = 0,42). Der aggregierte Effekt der eMHI bezogen auf die Reduktion des Alkoholkonsums war gering und nicht signifikant.

Unsere Ergebnisse legen nahe, dass betriebliche eMHI mit erheblichen Verbesserungen der psychischen Gesundheit verbunden sind, die je nach Bereich der psychischen Gesundheit in ihrer Effektivität variieren. Höhere moderate Behandlungseffekte wurden bei Stress, Schlaflosigkeit und Burnout erzielt. Dieses Ergebnis könnte eventuell durch den geringeren Grad an Stigmatisierung von Stress, Schlafstörungen oder Burnout erklärt werden, verglichen mit der

Stigmatisierung der psychischen Verfassungen, die mit der klinischen Diagnose einer psychischen Störung wie Depression, Angststörung bzw. Alkoholsucht verbunden werden. Es sind weitere Untersuchungen dazu erforderlich, welche genau Faktoren zur Varietät in der Effektivität von eMHI beitragen, insb. bezogen auf unterschiedliche Bereiche der psychischen Gesundheit, Charakteristika der Teilnehmenden bzw. unterschiedliche Interventionsarten.

Kapitel 2 „Präferenzen für E-Mental Health Interventionen in Deutschland: ein Discrete Choice Experiment".

Jüngste Erkenntnisse deuten darauf hin, dass E-Mental Health-Interventionen (eMHI) psychische Gesundheit wirksam verbessern können, Patient*innen jedoch nach wie vor zögern, diese anzuwenden. Frühere Untersuchungen haben ergeben, dass Patient*innen eMHI als weniger hilfreich empfinden als eine persönliche Psychotherapie. Die Gründe für diese ungünstige Wahrnehmung sind jedoch noch nicht umfassend ergründet. Unsere Studie zielte darauf ab, diese Frage zu beantworten, indem Präferenzen für einzelne Komponenten von eMHI in einem Discrete Choice Experiment (DCE) ermittelt wurden. Unter Verwendung eines schrittweisen qualitativen Ansatzes haben wir die folgenden fünf Attribute von eMHI herausgearbeitet: "Einführungstraining", "Kontaktart", "Peer-Support", "nachgewiesene Wirksamkeit", "Bereitstellung von Inhalten" und "Preis".

Darüber hinaus stellten wir Fragen zu Demografie, Einstellungen und früheren Erfahrungen der Befragten mit traditioneller Psychotherapie sowie zu ihrem Stresslevel. Insgesamt 1984 Teilnehmende beantworteten die Umfrage. Unter Verwendung gemischter Logit-Modelle stellten wir fest, dass die Teilnehmenden den persönlichen Kontakt mit einem Psychotherapeuten/ einer Psychotherapeutin im Kontext von Blended Care, nachgewiesene Wirksamkeit und niedrigen Preis besonders schätzten. Für die Teilnehmenden war die Art der Bereitstellung von Inhalten irrelevant, sie zeigten jedoch eine leichte Präferenz für ein Einführungstraining per Telefon sowie für Peer-Support über ein Online-Forum, begleitet von Gruppentreffen

vor Ort, die durch eine*n Trainer*in angeleitet werden. Unsere Ergebnisse deuten auf eine klare Präferenz für Blended Care hin, die den persönlichen Kontakt mit einem Psychotherapeuten/ einer Psychotherapeutin umfasst. Diese Präferenz blieb unabhängig von den soziodemographischen Charakteristika der Teilnehmenden, ihren früheren Erfahrungen mit Psychotherapie, dem Stresslevel und den beiden in unserem DCE verwendeten Kontextszenarien stabil. Weitere Untersuchungen zu den potenziellen Vorteilen und Risiken von Blended Care sind erforderlich.

Kapitel 3 „Präferenzen für blended E-Mental Health-Interventionen in Deutschland: ein Discrete Choice Experiment".

In der psychischen Versorgung entstehen zurzeit vermehrt digitale Behandlungsformate. Erste Evidenz legt nahe, dass Empfänger*innen und Anbieter*innen von psychischer Versorgung eine Kombination aus digitalen und traditionellen Formaten in der psychotherapeutischen Behandlung, auch Blended Care (BC) genannt, gegenüber eigenständigen digitalen Formaten bevorzugen. Wir untersuchten die Einstellungen und Präferenzen zugelassener Psychotherapeut*innen in Deutschland gegenüber solchen BC-Anwendungen. Wir führten eine Umfrage unter Psychotherapeut*innen durch, die Fragen zu Einstellungen, früheren Erfahrungen mit BC und Erwartungen gegenüber BC sowie ein Discrete Choice Experiment enthielt. Die Attribute für das Experiment wurden unter Verwendung eines schrittweisen qualitativen Ansatzes entwickelt. Ein Bayes'sches D-effizientes Design wurde verwendet, um die Choice-Aufgaben zu generieren. Die Choice-Daten wurden unter Verwendung gemischter Logit-Modelle analysiert. Zweihundert Psychotherapeut*innen absolvierten die Umfrage. Die Einstellung zu BC war überwiegend positiv, mit einer hohen berichteten Absicht, BC-Formate in der Zukunft zu verwenden. Im Choice-Experiment stellten wir fest, dass die Empfehlung einer Fachgesellschaft für eine BC-Online-Komponente der einflussreichste Faktor war. Eine höhere Effektivität und ein größerer Anteil der Präsenz- ggü. der Online-Zeit waren ebenfalls erwünschte

Merkmale, während ein finanzieller Anreiz zur Verwendung von BC weniger relevant war. Unsere Ergebnisse liefern Einblicke in die Entwicklung und Einführung von BC-Formaten. Die Feststellung, dass eine Empfehlung einer Fachgesellschaft das einflussreichste Merkmal in Bezug auf BC ist, zeigt, wie wichtig es ist, die Berufsverbände frühzeitig in die Entwicklung und Evaluation von BC-Formaten einzubeziehen. Darüber hinaus deuten unsere Ergebnisse darauf hin, dass finanzielle Anreize möglicherweise nicht wirksam sind, um eine breitere Akzeptanz von BC zu fördern.

7 Statement of personal contribution

Effectiveness of occupational e-mental health interventions: a systematic review and meta-analysis of randomized controlled trials.

Phillips, Elena; Gordeev, Vladimir; Schreyögg, Jonas

Personal contribution

- Analysis of the existing literature
- Development of the study design
- Development of the search strategy
- Literature search and selection
- Data extraction, analysis and synthesis
- Interpretation of the results
- Deriving recommendations for further research and practice
- Writing and revising the scientific article

Preferences for e-mental health interventions in Germany: a discrete choice experiment.

Phillips, Elena; Himmler, Sebastian; Schreyögg, Jonas

Personal contribution

- Analysis of the existing literature
- Development of the study design
- Development of the questionnaire and experimental design
- Data analysis
- Interpretation of the results
- Deriving recommendations for further research and practice
- Writing and revising the scientific article

Preferences of psychotherapists for blended mental health interventions in Germany: a discrete choice experiment.

Phillips, Elena; Himmler, Sebastian; Schreyögg, Jonas

Personal contribution

- Analysis of the existing literature
- Development of the study design
- Development of the questionnaire and experimental design
- Data analysis
- Interpretation of the results
- Deriving recommendations for further research and practice
- Writing and revising the scientific article

8 List of publications

Phillips EA, Gordeev VS, Schreyogg J. Effectiveness of occupational e-mental health interventions: a systematic review and meta-analysis of randomized controlled trials. *Scand J Work Environ Health.* 2019.

Phillips E, Himmler S, Schreyögg J. Preferences for e-mental health interventions in Germany: a discrete choice experiment. *Value Health* 2021 (forthcoming).

Phillips E, Himmler S, Schreyögg J. Preferences of psychotherapists for blended mental health interventions in Germany: a discrete choice experiment. *Under review at Psychother Res.*

.

Affidavit

I hereby declare, Elena Phillips, in lieu of an oath, that I have written the dissertation entitled „E-Mental Health – using digital technologies to advance mental health care“

autonomously - and if in cooperation with other scientists as described in the attached statement according to § 6 Abs. 4 of the doctoral regulations of the Faculty of Business Administration dated July 9, 2014

and that I did not use any other aids than those I indicated herein. The parts taken literally or by sense from other works than mine are marked as such.

I assure that I did not take advantage of any commercial doctoral consultation nor was my work accepted or judged insufficient in an earlier doctoral procedure at home or abroad.

Hamburg, 20.01.2021

Place, Date Signature