Effectiveness of internet-based and mobile-based interventions for adults with overweight or obesity experiencing symptoms of depression: a systematic review protocol

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ABSTRACT
Introduction  Internet-based and mobile-based interventions (IMIs) provide innovative low-threshold and cost-effective prevention and self-management options for mental health problems complementary to standard treatment. The objective of this systematic review is to summarise the effectiveness and to critically evaluate studies on IMIs addressing comorbid depressive symptoms in adults with overweight or obesity.

Methods and analysis  The study authors will systematically search the databases MEDLINE, Cochrane Library, PsycINFO, Web of Science, Embase and Google Scholar (for grey literature) for randomised controlled trials (RCTs) of IMIs for individuals with overweight or obesity and comorbid depressive symptoms without restrictions on publication date (planned inception 1 June 2023 to 1 December 2023). Two reviewers will independently extract and evaluate data from studies eligible for inclusion by assessing quality of evidence and qualitatively synthesising results. Preferred Reporting Items for Systematic reviews Meta-Analyses (PRISMA) standards and the revised Cochrane Risk of Bias tool in RCTs (RoB 2) will be applied.

Ethics and dissemination  Ethical approval is not required as no primary data will be collected. Study results will be disseminated through publication in a peer-reviewed journal and presentations on conferences.

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INTRODUCTION
Overweight and obesity are among the major global public health problems reaching near-pandemic levels. The worldwide prevalence of overweight and obesity has nearly tripled since 1975, with a steady upward trend. The WHO defines overweight and obesity ‘as abnormal or excessive fat accumulation that may impair health’, with adults having a body mass index (BMI) of ≥25 defined to be overweight and a BMI of ≥30 defined to be obese. In 2016, 39% of the world’s adult population were overweight and 13% were obese.

Obesity and overweight cause a number of adverse health consequences: they reduce physical as well as mental health and increase the risk of developing chronic diseases such as diabetes, hypertension or cancer. Obesity thus indirectly increases mortality and represents an important economic burden on the healthcare system. Overweight and obesity are also associated with increased negative psychosocial consequences and an increased prevalence of mental disorders, including depression as one of the most prevalent.

Depressive disorders belong to the most common mental disorders, with global cross-age point prevalence rates in 2019 of 3.8% and a proportion of 28.9% among all mental disorders, with increasing tendency. They are among the most significant contributors to the global burden of disease, causing significant direct and indirect costs. Major depression was associated with 2.79% higher direct costs.
in adolescents, with 2.58% higher direct costs in adults and with 1.73% higher direct costs in elderly compared with non-depressed individuals of the same age group.²¹ According to the Global Burden of Diseases (GBD), Injuries and Risk Factors Study 2019 depressive disorders account for the largest proportion (37.5%) of disability-adjusted life-years due to mental disorders.¹⁸

Standard care treatment methods for depression involve psychotherapy (eg, cognitive behavioural therapy (CBT), and psychodynamic therapy²²–²⁴), pharmacotherapy (eg, antidepressants) or a combination of both. This third pillar of treatment are other psychosocial therapies (eg, self-help, peer support, art therapy and sport therapy).

For obesity and comorbid depressive disorders, meta-analyses of cross-sectional studies²⁵–³¹ showed a pooled OR between 1.18 and 1.38 among individuals with obesity compared with eutrophic people to experience a depressive symptomatology in studies based on clinical diagnoses and/or self-reported symptoms (and OR=1.07 for overweight people³⁶). A meta-analysis of longitudinal studies³² identified obesity as a predictor for increased risk of onset of depressive symptoms at follow-up with OR=1.55 and overweight with OR=1.27. Associations are found for obesity with self-reported depressive symptoms, subsyndromal manifestations and clinically diagnosed depressive disorders.

Co-occurrence of overweight or obesity and depressive disorders amplifies the negative impact on physical and mental health and social life.³³ ³⁴ There is evidence for multiple causal directions:³ obesity and depressive disorders can be caused by the same mechanisms, for example, sharing the same dysregulations of some biological mechanisms such as neurotransmitter balance, immunoinflammatory processes or oxidative stress.³⁵–³⁸ Obesity can cause or aggravate depression, for example, psychosocial factors such as weight discrimination and double stigma of obesity and mental disorders can also act as chronic stressors and aggravate depressive symptomatology.³⁹ ⁴⁰ Depression can cause or aggravate obesity, for example, as a result of symptoms such as increased eating behaviour, decreased activity and exercise³⁷ or due to weight gain as a psychopharmacological side effect.⁴¹ Comorbidity may also lead to a number of interactions, for example, reduced efficacy of antidepressants in people with obesity.³² There is empirical evidence of a higher prevalence of comorbid depressive disorders¹³ ²⁵–²⁸ ³⁰ ³¹ in women with overweight or obesity.

The effectiveness of internet-based (delivered via web browser on desktop, laptop, tablet computer or smartphone) and mobile-based (delivered via smartphone app) interventions (IMIs) has been demonstrated for a wide range of mental health conditions.⁴³–⁴⁵ They can be applied as an innovative, efficient, low-threshold and location-independent prevention and treatment method to complement existing outpatient and inpatient services and to offer support while waiting for therapy vacancies.⁴³–⁴⁶ They are appropriate for different target and risk groups. IMIs for depressive disorders are effective and have a high acceptance of use with effectiveness comparable to conventional ‘face-to-face’ interventions.⁴⁴ ⁴⁷ ⁴⁸ They can be accessed at low thresholds and relatively low costs.⁴⁸–⁵¹ Nevertheless, potential risks and adverse effects may occur, such as mental overload or limited ability to respond to acute crises.⁵² However, some studies have shown that patients using IMIs experience significantly less deterioration in their mental health than those in control group conditions (such as attention placebo, no treatment, treatment as usual (TAU) or waiting list).⁵² ⁵³ Research also suggests that subgroups of individuals may benefit less from IMIs if these interventions were not adequately tailored to their specific needs.⁵⁴

Given the high prevalence of overweight, obesity and depressive disorders alone, as well as overweight or obesity with comorbid depressive disorders, there is a high demand of cost-effective interventions. IMIs tailored to the specifics of overweight or obesity with comorbid depressive disorders could mitigate this need. Current systematic reviews and meta-analyses show that IMIs have been established as effective and acceptable in weight loss and physical activity management.⁵⁵–⁶⁰ A recent review of mobile interventions for the management of overweight or obesity with comorbid depressive disorders⁶¹ found no single smartphone-based intervention that addressed both the physical and mental illness equally and most of the identified studies focused on the monitoring of weight and physical activity. We found no review of internet-based interventions for people with overweight or obesity and comorbid depressive disorders. Yet there is an increasing number of randomised controlled trials (RCTs) of specific IMIs with psychotherapeutic elements that address both overweight or obesity with comorbid depressive symptoms.⁶²–⁶⁴ To the best of our knowledge, there is no review which reflects the current state of research of IMIs with psychotherapeutic elements for adults with overweight or obesity and comorbid depressive disorders.

Objectives

Therefore, the purpose of this planned study is an systematic evaluation and synthesis of empirical findings based on RCTs of IMIs for adults aged 18 years and older with overweight or obesity who experience comorbid depressive symptoms, focusing on the effectiveness of these interventions (eg, the improvement of objective measures of depressive symptoms) compared with treatment-as-usual, low-level support or no intervention. We only include RCTs with an adult population because there are significant differences in treating obesity in adults compared with children and adolescents⁶⁵ –⁶⁶ and also in tailoring IMIs to the need of younger age groups.⁶⁷ If possible (depending on the number of eligible studies), it is also planned to combine data across RCTs for an estimation of pooled effect sizes for the reduction of depressive symptomatology.

METHODS AND ANALYSIS

This review protocol outlines the planned strategies for a review of RCTs on the topic of IMIs for adults with overweight or obesity and comorbid depressive disorder. It describes how data will be systematically evaluated and
synthesised to examine the effectiveness of these IMIs according to the 24-step guide by Muka et al.68 It follows the Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA)-statement for systematic reviews.69 Therefore, the study selection process will be in accordance with the four-phase PRISMA flow diagram (figure 1).

**Eligibility criteria**

The planned review will follow the PICO scheme (population, intervention, comparison, outcome) and include effectiveness RCTs involving adults aged 18 years and older with overweight or obesity and comorbid depressive symptoms (participant criteria) applying IMIs. The studies must examine clinical psychological interventions as defined by Kampling et al29 (intervention criteria):

- CBT.
- Psychodynamic psychotherapy.
- Behaviour therapy or behaviour modification.
- Systemic therapy.
- Third wave CBT.
- Humanistic therapies.
- Integrative therapies.
- Other psychological-oriented interventions.

Any type of control condition with the following types of comparison groups will be included (comparison criteria):

- TAU (referring to psychotherapy, pharmacotherapy or both).
- Waiting list.
- Low-level support.
- Psychosocial support.
- Attention placebo (both researcher and participants are inactive).
- Psychological placebo (participants are active and researchers inactive).

Any measures of effectiveness (eg, improvement of objective measures of depressive symptoms) will be included (outcome criteria). Data from clinician-rated scales will be rated higher than self-report questionnaires. The literature search will cover articles written in English or German (language criteria) and will not be restricted by publication date. Articles examining a highly specific population (eg, pregnant women or a population with a specific somatic disease) will be excluded.

**Information sources and search strategy**

It is planned to include the following databases in the literature search (planned inception 1 June 2023–1 December 2023): MEDLINE (via PubMed Interface), Cochrane Library, PsycINFO, Web of Science, Embase and Google Scholar (for grey literature). KS and another researcher (NN) will search independently using the following combination of search terms: (1) obesity or overweight or adiposity or metabolic syndrome or body mass index; and (2) depress*, (3) internet or online or web or computer or mobile or app or smartphone or m-health or mobile health or e-mental health or iCBT or cCBT or IMI and (4) intervention or psychotherapy or therapy or cognitive behavioral therapy or cbt (restricted to title and abstract) (see online supplemental file). The MEDLINE search strategy will be adapted to specifications of each database.

Both researchers will screen titles and abstracts and, when eligible, full texts of the studies will be assessed for the defined criteria. In addition, reference lists of all included studies and systematic reviews will be searched manually to identify further potentially relevant articles, and a grey literature search for unpublished studies will be conducted using Google and Google Scholar with the search terms. Searches will be rerun before starting the final analysis to include more recently published studies.

**Data management**

The authors plan to use the software package Review Manager Web (RevMan Web) V.4.12.0,71 which was specifically designed for the management, analysing and synthesising bibliographic information and data from systematic reviews, or another suitable software. Additional data analyses and meta-analyses will be conducted using SPSS V.27.0.72

**Selection process**

KS and another researcher (NN) will screen all titles and abstracts independently and divide the retrieved articles into the categories ‘potentially relevant’ (matches the eligibility criteria), ‘irrelevant’ (does not match the eligibility criteria) and ‘uncertain’ (information is inconclusive
Data collection process and data items

A standardised data extraction form for the extraction of the study data will be developed. To ensure that all relevant data will be extracted correctly, both reviewers will independently test the pilot version of the form on a subsample of relevant articles, discuss difficulties and adopt the data extraction form accordingly. Both reviewers will extract data from each study independently. Discrepancies in each step will first be discussed between both reviewers, and, if they cannot be solved, then with a third senior researcher (MaL). In case of missing data, study authors will be contacted.

The following data will be extracted:

1. Study identification items (eg, first author, year of publication country).
2. Study design characteristics (eg, sample size, recruitment strategy, inclusion and exclusion criteria, classification of obesity levels, assessment of depression, assessment of concurring conditions like comorbidities and pharmacotherapy or psychotherapy, intervention design/duration, control group condition, follow-up assessments).
3. Participant characteristics (eg, mean age and age range, gender).
4. Methodological factors (eg, risk of bias, study limitations).
5. Outcome data (in case of follow-up assessments, all waves will be included): effectiveness= reduction of depressive symptoms.

Quality assessment

The authors plan to use the revised Cochrane Risk of Bias tool in RCTs (RoB 2). KS and another researcher (NN) will independently assess the methodological quality of the included studies in the following domains:

1. Bias arising from the randomisation process.
2. Bias due to deviations from intended interventions.
3. Bias due to missing outcome data.
4. Bias in measurement of the outcome.
5. Bias in selection of the reported result.

On this base, all studies will be assigned to the three corresponding overall risk-of-bias-grades following: ‘high risk of bias’ (at high risk of bias in at least one domain, or some concerns for multiple domains), ‘some concerns’ (some concerns in at least one domain, but no high risk of bias for any domain) and ‘low risk of bias’ (low risk of bias for all domains). Discrepancies will first be discussed between both reviewers, and, if they cannot be solved, then in a discussion with a third senior researcher (MaL). In case of missing methodological information, study authors will be contacted. In the risk of bias table, results of the ratings will be shown for each domain.

Data synthesis and presentation

The characteristics (as listed under ‘Data collection process and data items’) of all included studies will be presented in a narrative synthesis, starting with study and sample characteristics and descriptions of intervention and control group conditions, followed by outcome measurements, effect sizes and overall results.

If a sufficient number of eligible studies is found, an optional second part will be done. The authors will include these studies in a meta-analyses that provide quantitative measures of depression and analyse heterogeneity between RCTs with the use of I² statistics, funnel plots and forest plots. A moderate level of heterogeneity of 30%–60% between studies for I² will be assumed according to the Cochrane standards. If studies fail to show sufficient heterogeneity (I²<60 %) in at least two trials, meta-analytic pooling will not be undertaken. Since the cause of inconsistency may result from study characteristics, sources of heterogeneity in subgroups of studies in terms of type of BMI classification (overweight or obesity) or intervention type (type of psychotherapeutic intervention) will be explored. As studies with different outcome measures (depressive symptoms) and various interventions will be included, a random-effects model will be applied and standardised mean difference values and their associated 95% CIs will be estimated. In case of missing date, the authors will handle them according to the Cochrane Handbook for Systematic Reviews of Interventions. RevMan Web V.4.12.0 or another eligible software will be used for data analyses.

Patient and public involvement

No patient involved.

Ethics and dissemination

Patient/public consent for publication: as no primary data will be collected, ethical approval and consent to participate are not required. The results of this systematic review are intended to be published in an international peer-reviewed journal and be presented at relevant professional conferences.

Contributors

All authors contributed substantially to the conception of the work; KS and MaL drafted the manuscript; MeL and SGH revised the manuscript critically for important intellectual content; all authors finally approved the version to be published. All authors gave agreement to be accountable for all aspects of the work.

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REFERENCES

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64 Bt Wan Mohamed Radzi CW, Salarzadeh Jenatabadi H, Samsudin N. mHealth Apps assessment among postpartum women with obesity and depression. *Healthcare (Basel)* 2020;8:72.
Example for search strategy:

MEDLINE via PubMed

(((obesity[Title/Abstract] OR overweight[Title/Abstract] OR adiposity[Title/Abstract] OR "metabolic syndrome"[Title/Abstract] OR "body mass index"[Title/Abstract])

AND

(depress*[Title/Abstract]) )

AND


AND

((intervention[Title/Abstract] OR psychotherapy[Title/Abstract] OR therapy[Title/Abstract] OR "cognitive behavioral therapy"[Title/Abstract] OR cbt[Title/Abstract]))