Funded by
the European Union

MENTBEST

Protecting
mental health
in times of change.

MENTBEST

Protecting mental health in times of change

Depression-related self-help content and adherence-improving in English aspects ready for localisation

Document date: 30/09/2024
Document version: 1.2
Deliverable No: 5.2

Funded by
the European Union

Funded by the European Union. Views and opinions expressed are however those of the author(s) only and do not necessarily reflect those of the European Union or the European Health and Digital Executive Agency (HADEA). Neither the European Union nor the granting authority can be held responsible for them.

MENTBEST Consortium

Full Name	Short Name	Beneficiary Number	Role
EUROPEAN ALLIANCE AGAINST DEPRESSION	EAAD	1	Coordinator
INSTITUTO DE SAUDE PUBLICA DA UNIVERSIDADE DO PORTO	ISPUP	2	Beneficiary
UNIVERSIDAD AUTONOMA DE MADRID	UAM	3	Beneficiary
NATIONAL SUICIDE RESEARCH FOUNDATION	NSRF	4	Beneficiary
REGION HOVEDSTADEN	PCC	5	Beneficiary
DET NATIONALE FORSKNINGSCENTER FOR ARBEJDSMILJØ	NFA	6	Beneficiary
EESTI-ROOTSI VAIMSE TERVISE JA SUITSIDOLOOGIA INSTITUUT	ERSI	7	Beneficiary
STIFTUNG DEUTSCHE DEPRESSIONSHILFE UND SUIZIDPRAEVENTION	**GDF**	**8**	**Beneficiary**
QENDRES SE SHENDETIT DHE MIREQENIES KOMUNITARE	CCHW	9	Beneficiary
KATHOLIEKE UNIVERSITEIT LEUVEN	KUL	10	Beneficiary
MONSENSO A/S	MSS	11	Beneficiary
PINTAIL LTD	PT	12	Beneficiary
KENTRO EREVNON NOTIOANATOLIKIS EVROPIS ASTIKI MI KERDOSKOPIKI ETAIREIA	SEERC	13	Beneficiary
FUNDACIO INSTITUT HOSPITAL DEL MAR D INVESTIGACIONS MEDIQUES	IMIM	14	Beneficiary

Version Control

Version	Changes	Date
1.1	After internal review by SEERC, details were added to the different sections and more citations were added to support the claims made in this deliverable.	17.09.2024
1.2	Final for submission	23.09.2024

D5.2 DEPRESSION-RELATED SELF-HELP CONTENT AND ADHERENCE-IMPROVING IN ENGLISH ASPECTS READY FOR LOCALISATION

Contents

1. Executive Summary 4

2. Introduction and Background 4

3. Approach 5

3.1 Self-help Content development: 5

3.1.1 Review of existing resource 5

3.1.2 Choice of relevant topics 6

3.1.3 Revision and adaptation of content 6

3.1.4 Localization 6

3.2 Development of rules 7

3.2.1 Assessment of possible data points/choice of questionnaires 7

3.2.2 Review of literature to search for recommendations in the respective fields 7

3.2.3 Development from rule sketches to final rules 8

3.3 Gamification and adherence improving elements: 8

3.3.1 Scientific overview of possible element and choice of fitting and possible alternatives 8

4. Results 8

4.1 Co-Creators meeting results 8

4.2 List of self-help content 9

4.3 Rules 9

4.4 Description of adherence enhancing elements 10

5. Impact and Conclusion 11

6. Appendices 12

6.1 Appendix 1 – list of all articles and activities for the MENTINA library 12

6.2 Appendix 2 - example of an article from initial curriculum 14

6.3 Appendix 3 - example of an article recommended when a rule triggers 16

7. Literature: 17

1. Executive Summary

This deliverable report outlines both the process and outcome of the development of self-help content and rules to be included in the MENTINA app (WP5, Task 5.2). This includes psychoeducational materials, Cognitive Behavioural Therapy (CBT)-based self-management elements as well as further self-management elements addressing distress and sub-clinical depressive symptoms and generalized anxiety. Furthermore, the design process for the rules that will control the personalized feedback is described. The resources that were used as a basis and the adaptation process are described as well as the role of different partners/work packages and the involvement of the Co-Creators. Interdependencies within the project are highlighted, as this deliverable directly supports the continued work on the MENTINA app that will be WP5's main output (D5.5). Finally examples of the adapted and newly developed content as well as the rules to deliver personalized feedback will be given.

2. Introduction and Background

The MENTINA App that is currently developed in WP5 based on the existing solution by Monsenso will be a unique and novel combination of established elements and sophisticated data-based personalized feedback that enables users to learn more about Depression and General Anxiety and get insights into their own symptoms and how they relate to behaviour (e.g. physical activity or sleep).

The evidence base for digital interventions based on CBT for depression has grown over the last years and is now incontestable [1,2]. Browser- and mobile based interventions have been developed tested and are being implemented into routine care and have the potential to lower the burden of the most common mental disorders on the healthcare systems.

On the other hand, results are quite clear in that guidance by a healthcare professional (be it in person, via telephone or through messages) seems to increase both adherence and effectiveness[3]. This links successful implementation to a resource that is scarce in many countries: healthcare professional time/availability. Therefore, the MENTINA app will be fully self-guided, but include rule based feedback and content recommendation to give users the experience of being guided and seen in the intervention[4].

The self-help content whose development is outlined in this deliverable will be recommended to users partly based on a fixed schedule (to ensure new content recommendations especially at the beginning of the intervention, when not enough data has been collected for the rule-based recommendation) but mostly in a personalized manner fitting their symptoms and symptom-behaviour associations. This ensures, users receive recommendations for content that is relevant to them.

Furthermore, adherence enhancing elements (e.g. gamification elements such as badges to be earned by completing certain activities in the app) will be included in the intervention to support adherence and engagement with the intervention even by people who might struggle with motivation due to their underlying symptoms [5]. The goal is to create an intervention that is easily incorporated into everyday routines and provides useful content as well as visualization of data and personalized feedback for better self-management of symptoms of depression and generalized anxiety. This is in line with the primary goal of MentBest, as vulnerable groups will

receive access to an evidence-based intervention to reduce symptoms of depression and potentially delay or prevent onset of new episodes of depression.

D5.2 received input from WP1 via the Scoping Review on interventions reported in D1.1, from WP2 (task 2.2, development of COMBINA materials) as well as through co-creator involvement established by WP7. This deliverable is an important milestone in the intervention development and is related to task 5.2 and 5.4. It directly feeds into D5.5, where localized content is included in MENTINA. It is an integral part of the development of the MENTINA app and builds the basis for the trial planned and executed by WP6 (task 6.3 with D6.3 and D6.4) as well as for the development of enhanced MENTINA, which will take place after the Randomised Controlled Trial (RCT) has been conducted based on the data collected in three countries (Spain, Germany and Denmark).

3. Approach

This part of the report describes the work carried out in accordance with Task 5.2 and 5.4 by WP5 and indicates who was involved in the different tasks.

3.1 Self-help Content development:

3.1.1 Review of existing resource

Before content development commenced, an internal review of the available resources within our consortium was conducted by MSS, GDF and IMIM. **D1.1** was used as a resource to identify what where the most promising interventions recommended in the Scoping Review. The following mechanisms of change were identified in D1.1:

- Changing people's fear, hopelessness and thought related distress was identified as significant mechanisms of change in digital interventions. Therefore, material on changing negative thoughts and on negative self-perception (in "typical problems") was added to the MENTINA material
- Good quality social connections were identified as mediator for depression and generalized anxiety (for young people), therefore a module on building a positive social network was included.

While the effect of physical activity intervention for young people was described as equivocal in WP1 Scoping Review, we deepened the research specifically for adults at risk or with a history of depression and decided to still include interventions targeting physical activity, as in MENTINAs target group they have a good chance to enhance well-being and help manage depression[6].

An internal exchange with **WP2** about the material developed for COMBINA took place and inspiration was taken from the topics chosen to be part of COMBINA. The **iFightDepression tool** (an evidence-based digital intervention based on CBT that is implemented in several countries across Europe and includes psychoeducational material) was considered as a source of existing content to be used and modified. Finally, **content that was already existent in the MSS system** was considered. Stemming from earlier projects, a variety of articles are already tested and available. This large source was reviewed for content that suits the needs of future MENTINA users.

3.1.2 Choice of relevant topics

Both MSS and GDF have extensive experience in creating digital interventions. Added clinical expertise by GDF and IMIM and PCC was considered in the choice of topics for the library. “The library” is the technical term for the place in the app that lists all the informational content (referred to as “articles”) so that users can browse through it and look at topics that pique their interest.

The content chosen was selected to serve two main purposes:

1. Give users of the app an introduction to what depression and generalized anxiety is and how it can be treated to create a common understanding. Therefore, a curriculum for the first 6 weeks of intervention use was created.
2. Create a selection of articles that can be recommended based on certain patterns that could be identified in the individual user data (e.g. worsening of symptoms of depression or indications for sleep disturbances)

All articles created for the library needed to address a certain topic and put together information in a brief and easy to understand manner.

The choice of topics was then presented to the Co-creators in a designated meeting to get their feedback on relevance and importance of the topics. This further influenced the choice and the order of the content to be presented in MENTINA.

In a consortium meeting, the final list of topics to include in MENTINA was presented to all partners for feedback.

3.1.3 Revision and adaptation of content

After the topics for library articles were chosen, existing pieces of content were collected from the different resources and put together. Their relevance was assessed, and necessary changes were made. The main goal was to adapt the content so that it would be easy to read on a mobile phone. This requires short tests, regular breaks and the use of graphics/drop down parts (accordions) that include optional information that users can open if they are interested. This task was mainly carried out by GDF and IMIM. A final review round of the content was conducted by all WP5 members.

3.1.4 Localization

Localization of the content happened with regard two both wording and information included in the articles. During the translation process, the members of WP5 in each implementation country took care to adapt wording to their own culture. This means choosing metaphors or descriptions that are relatable to the target group in the respective RCT countries.

Other articles (specifically those giving information on the local healthcare system) needed localization. Helplines, descriptions on how to seek treatment as well as sources e.g. about how to talk to your child about depression were rewritten by the local teams of WP5 to fit the countries specificities.

3.2 Development of rules

3.2.1 Assessment of possible data points/choice of questionnaires

Rule based feedback and personalized content recommendations are meant to be an integral part of the MENTINA intervention and give user the feeling of being seen even though the intervention is fully self-guided. To establish a set of rules that will deliver meaningful feedback to the users, the available data sources where reviewed.

The first group of data sources are the measures/tools developed for the evaluation of MENTINA (WP6). Those were chosen in close collaboration with WP6, as most self-report measures serve a double function as RCT outcomes and as user's data for MENTINA. As the target parameter of the trial (validated measures of depression, perceived stress, generalized anxiety) are also the target of the intervention, they serve as a meaningful and reliable data source. The goal was not to overburden users with questions but still collect as much data as needed to identify patterns and provide feedback. As an addition to the bi-weekly self-report scales, a daily rating was included to collect information on sleep and daily mood to enable rules on these topics.

The second group of data sources are sensor and system data passively collected by the users' smartphone. Monsenso already had functionality implemented to capture data from different data sources (if users consent to this). These data sources (Android and iOS: battery level, geolocation, activity, step count. Android only: light, screen state. Newly added for Android: app usage data) where reviewed to assess if they are candidates to make up meaningful rules.

3.2.2 Review of literature to search for recommendations in the respective fields

To make a well-informed decision on how to build feedback/recommendation rules, the literature was searched for papers that show both correlational as well as causal relationships between mental health and our data sources.

Especially in newer studies on digital biomarkers, those relations have been described but the analysis of data was usually performed after the trial ended, so user's data based feedback was not possible [7,8], highlighting the innovation of the MENTINA development.

The following data sources were chosen due to their evidence-based association to mood/anxiety and depression:

- Physical Activity (operationalized as minutes spent active as tracked by the users phones accelerometer), as its relationship with depression has been repeatedly shown[6,9]
- Step count, which is similar to activity, but can still be an easy-to-understand metric that has clear recommendations for healthy behaviour
- Smartphone usage (operationalizes as hours of unlocked screen) as it has been shown to be associated with symptoms of depression (especially in younger people). But as for some participants, smartphone usage as such could be part of their job or their daily routine, it was decided to add a new data source to better capture this relevant feature. Especially extended use of social media has been associated with symptoms of depression in the literature. Therefore, data on how long each type of app is used was added as a new data source that should be more relevant, based on the literature[10–12].

- Sleep (assessed in MENTINA using self-report on hours slept and hours awake during the night) is closely related to symptoms of depression and mental health in general and can therefore be an important marker[13–16]

3.2.3 Development from rule sketches to final rules

The final steps of rule development required close communication between GDF and the MSS development team. We started out with a rough sketch of each rule that we considered relevant based on the literature and then connected this to the technical aspects of the MENTINA app to ensure stability and safety of the rules.

A semi-final set of rules was presented to a group of clinicians to get their feedback on how relevant they thought the content recommendations and feedback based on rules would be for patients.

The Co-creators were also involved and were asked for instance about the tone of voice and amount of detail and information given in the feedback.

3.3 Gamification and adherence improving elements:

3.3.1 Scientific overview of possible element and choice of fitting and possible alternatives

To make an informed decision on which adherence enhancing elements or gamified elements should be included in the app, the current literature was reviewed. According to persuasive system design framework, persuasive elements can be categorized into primary task support features (e.g. tunnelling, tailoring or personalization), dialogue support features (e.g. praise, rewards, reminders), social support features (e.g. competition, social comparison) and credibility support features (e.g. surface-credibility, authority, or third-party endorsements). While primary task support features are the most common in digital interventions, this does not mean that they are the most relevant[17]. Therefore, strategies from each category were chosen to be included in MENTINA except for the social support category. Social support was not included as diminished self-worth and hopelessness can be symptoms of depression and an unfavourable social comparison might have negative effects in this specific group.

4. Results

This part describes the outcome of Task 5.2 and 5.4 by WP5 based on examples and illustrations.

4.1 Co-Creators meeting results

The meeting with the Co-creators consisted of informational input on how and why a RCT is necessary for the development of an app as well as an introduction to MENTINA to get co-creators on board.

After the initial talk, feedback was collected on several different topics. Here are some examples that helped in the design process of MENTINA:

- Rating of proposed library content by relevance: this helped us choose the right order in which to present content, so it seems most relevant to users. Based on this, a schedule for some initial content recommendations was build.
- Push notifications: Co-creators gave feedback on how often they would like to get push notifications by MENTINA (2-4 times a day way chosen), and what kind of notifications they would like to receive.
- Wording of feedback messages: the co-creators were asked to indicate which option out of several feedback messages they would prefer to get. Their rating made clear that short messages where preferred over more detailed ones in almost all cases and this was considered when writing all the feedback options in MENTINA

The detailed report on the Co-creators meeting will be included in D7.2 which will be submitted in parallel to this deliverable.

4.2 List of self-help content

A full list of the titles of articles and "activities" (interactive, worksheet like elements) that make up the MENTINA library can be found in appendix 1 (6.1). The articles comprise text and visualization. Relaxation/mindfulness practices will be recorded as a podcast to be included before the study starts. Videos are not part of the workshops, as translation and possible incorporation of updates based on the study results would be extensive. Video messages from the local teams of each trial site in the implementation countries to keep users engaged are planned and will be included after the rule implementation has been completed.

As an example for the articles, that will be shown to all users during the initial curriculum, the article "Depression or bad mood?" is added as appendix 2 (6.2). To illustrate how personalized content that is recommended based on a rule looks, the article "an active lifestyle" is added in appendix 3 (6.3). This article will be recommended, when app users allow the app to track their activity and MENTINA identifies that there is low activity level.

To see the full content of the library in its' English version ready for localization, please use the login to the app provided alongside this deliverable.

4.3 Rules

The final list of rules incorporates different types of rules. Some just use one data source and either recommend content based on this or give personalized feedback to the users. Some examples for these rules are:

- PHQ-9 sum-score of 10 or more points. This indicates that users might have symptoms of depression. If they reach this point, content on depression and self-management techniques on how to handle symptoms of depression are added to the content recommendation list. There are several articles, that are consecutively recommended each time users score in the relevant range.
- PHQ-9 sum score is greater than 19. This indicates the possibility of severe symptoms of depression. In this case users are informed about their current level of self-reported

symptoms and are asked to seek further help. Information on how to seek treatment for depression is provided.

- Minutes of weekly physical activity as tracked by the user phone is larger than 150 minutes. Physical activity is a relevant predictor for mental and physical health and being active for at least 150 minutes per week with mild to moderate intensity seems to be beneficial. Therefore, users receive personalized feedback on their weekly activity and are praised if they reach the targeted amount.

There are other rules that connect different data sources and feedback if there are relevant relationships in the data of each particular user. In MENTINA, granger causality will be calculated between two time series and if there is a significant relationship that exceeds a certain effect size, this will be fed back to the user. See some examples here:

- Significant granger causality between daily activity and daily mood during the following days. If this is found, user will receive a content recommendation for an article on physical activity and depression and the following feedback message:
  "We detected a relevant relationship in your data. When more physical activity was tracked by your phone, your mood tended to be better the next days. While this can be caused by many things, an active lifestyle has been shown to be helpful to improve the mood for many people and it might be the case for you."
- Significant granger causality between time spent on social media and daily mood during the following days. If this is found, users will receive the following feedback message:
  "For you, longer times spent on social media apps was followed by worse mood the next days. While this connection could be cause by other factors, we know from research that extensive use of social media can be harmful for the mood and mental health. You could explore how reducing social media time affects your mood and energy."

4.4 Description of adherence enhancing elements

To improve adherence, several persuasive system elements were included:

Primary task support features (e.g. tunnelling, tailoring or personalization)

- Tunnelling was used for the initial content. A curriculum of articles that build upon each other was built and will be recommended during the first 6 weeks. Every few days a new article will show up to keep users engaged.
- Personalization is given when articles are recommended, or feedback is given based on questionnaire scores or sensor/system data

Dialogue support features (e.g. praise, rewards, reminders)

- As rewards, a badge system will be introduced. Bronze/silver/gold can be earned for e.g.: regularly filling in daily ratings, reading the recommended content
- Reminders are a part of the system, so that users are regularly reminded of questionnaires that are still open as well as unread messages
- Pre-configured reminders and messages informing the user about their progress through the study and thanking them for their important role as a contributor to science are included to strengthen motivation of the users

- If the automatically tracked behaviour (e.g. activity and steps) or the self-documented sleep if in the recommended range, praise is sent to the users to acknowledge health-supportive behaviour

Credibility support features (e.g. surface-credibility, authority, or third-party endorsements)

- All content is based on current scientific knowledge and established techniques used psychotherapy, this gives credibility

5. Impact and Conclusion

This document described the process of content development for the MENTINA app library (task 5.2) as well as the adherence enhancing features and personalized feedback (task 5.4). It gives a detailed view on what steps were taken and who was involved. The results are described, and examples are added for a better understanding.

The content that was developed is an important milestone in the development of the MENTINA app and contributes to the accomplishment of deliverables 5.3 and 5.5.

Based on the content and design decisions that are outlined in this document, the MENTINA app will be configured to be used in the MENTINA trial. It is also a strong evidence base on which to give recommendations for an enhanced MENTINA (D5.4) later in the project.

6. Appendices

6.1 Appendix 1 – list of all articles and activities for the MENTINA library

1. About this app
    1.1 Introduction
    1.2 How do the rules work?
2. Understanding Depression
    2.1 Depression or bad mood?
    2.2 Depression - a mental or a physical disorder?
    2.3 Causes and course of Depression
    2.4 Typical problems
    2.5 Anxiety and Depression
3. How is depression treated?
    3.1 Psychotherapy
    3.2 How to start psychotherapy
    3.3 Medication
4. Understanding Anxiety
    4.1 What is Anxiety?
    4.2 Anxiety triggers
    4.3 Anxiety “fuel”
    4.4 Exercise and Anxiety
5. What helps to stabilize the mood?
    5.1 An active lifestyle
    5.2 Relaxation
    5.3 Mindfulness
    5.4 Sleep Regulation
    5.6 Establishing a positive social network
    5.7 Sleep Hygiene
6. Strategies to handle depression
    6.1 Recording activities, planning activities
    6.2 Discovering my values
    6.3 Exploring pleasurable activities and mastery
    6.4 Behavioural Activation Tips

6.5 Negative automatic thoughts

6.6 Therapeutic sleep restriction

6.7 Identifying my warning signs

6.8 Exercise and Depression

6.2 Appendix 2 - example of an article from initial curriculum

Depression or bad mood?

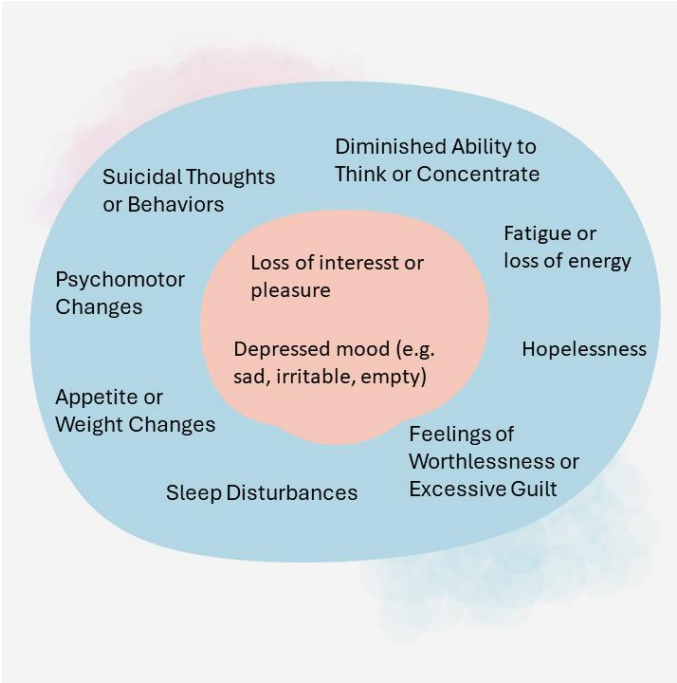
The differences between a depressed mood and a depressive disorder

Almost everyone experiences times of feeling down. Being in a specific mood can last for several hours or for longer periods of time and changes in mood are a very normal part of life. However, if low spirits and low energy persist and are combined with additional symptoms such as negative thoughts and feelings, loss of interest, sleeplessness, or hopelessness, it could be a depressive episode.

What is depression?

A depressive episode is more than just “having a few bad days”. It is a medical condition that is characterized by a lowered mood that lasts for at least two weeks. A person with depression feels persistently sad, low, and may feel numb, as though they have lost the ability to feel anything at all. Besides a lowered mood, depression is characterized by decreased interest. People with depression may find it difficult to experience joy or interest in activities that they have enjoyed before. They can also feel very tired and low on energy. Daily activities can seem extremely daunting, and it can seem unmanageable to do small activities, such as getting up, taking a shower, and leaving the house.

To diagnose the condition, healthcare professionals use the following criteria:



Other symptoms

Depression also has other symptoms. Sleep is often disturbed, either in the form of difficulties falling asleep, interrupted sleep or early awakening. The person can also have lowered self-confidence and self-worth as well as a tendency to isolate themselves.

Depression affects a person's feelings, thoughts and behaviour and can also lead to physiological changes, e.g. digestive problems or a heightened perception of pain.

Course of an episode

A depressive episode often develops gradually and begins with discrete symptoms, such as sleep disturbances or fatigue. However, it can also develop more suddenly and rapidly, without gradual symptoms. Without treatment, a depressive episode typically lasts from weeks to months, but in some cases the state can extend over longer periods.

Difference between depressed mood and depressive episode

Everyone knows about phases in life when there is nothing to look forward to, everything seems grey and then might refer to themselves as "depressed". Stressful situations at work, the weather or a personal disappointment can be experienced as depressing. The term “depression” is often used to describe everyday fluctuations in mood. But depression in the medical sense is different to a temporary phase of low mood that occurs in the course of almost everyone's life.

This everyday use of the term depression can be misleading. If an affected person or their relatives assume that a lack of joy, depressed mood and hopelessness are reactions to problems and not an expression of an independent, treatable illness, there is a high risk that professional help will not be sought. So it is important to make a clear distinction.

6.3 Appendix 3 - example of an article recommended when a rule triggers

An active lifestyle

Regular exercise helps us to stay healthy in the long term. This applies to both physical and mental health. The likelihood of cardiovascular disease and type 2 diabetes decreases, back pain occurs less frequently, and the occurrence of depression and anxiety disorders is reduced.

How much exercise is necessary?

And you don't need extreme sports to have these positive effects! The WHO recommends at least 150 minutes of moderate exercise per week for adults or at least 75 minutes of intense exercise.

Moderate exercise refers to activities that increase your heart rate but still allow you to chat comfortably at the same time while intense activities get your heartrate up, make you sweat after a few minutes and here it is difficult to say more than a few words without catching your breath. Ideally, this should include muscle-strength training at least 2 days a week.

Every small step counts!

But even if these goals are not (yet) achievable, every small step in this direction has a positive effect on your health. Especially if you are just starting out, the intensity should be increased slowly.

Exercise recommendation:

- Use your everyday commute as an opportunity for movement. Can distances in everyday life be covered on foot or by bike instead of by car or public transport?
- Use sports courses, it is easier to stay motivated together. Affordable sports courses are often offered by regional clubs or colleges.
- Try out online classes. There are many free classes for all levels of fitness available online. You can try out different trainers and see what suits you best.

7. Literature:

1. Cuijpers P, Noma H, Karyotaki E, Cipriani A, Furukawa TA. Effectiveness and Acceptability of Cognitive Behavior Therapy Delivery Formats in Adults With Depression: A Network Meta-analysis. *JAMA Psychiatry*. 2019;76(7):700. doi:10.1001/jamapsychiatry.2019.0268

2. Karyotaki E, Efthimiou O, Miguel C, et al. Internet-Based Cognitive Behavioral Therapy for Depression: A Systematic Review and Individual Patient Data Network Meta-analysis. *JAMA Psychiatry*. 2021;78(4):361-371. doi:10.1001/jamapsychiatry.2020.4364

3. Baumeister H, Reichler L, Munzinger M, Lin J. The impact of guidance on Internet-based mental health interventions — A systematic review. *Internet Interv*. 2014;1(4):205-215. doi:10.1016/j.invent.2014.08.003

4. Ly KH, Ly AM, Andersson G. A fully automated conversational agent for promoting mental well-being: A pilot RCT using mixed methods. *Internet Interv*. 2017;10:39-46. doi:10.1016/j.invent.2017.10.002

5. A Systematic Review of the Effect of Gamification on Adherence Across Disciplines. In: *Lecture Notes in Computer Science*. Springer International Publishing; 2021:168-184. doi:10.1007/978-3-030-77277-2_14

6. Hu MX, Turner D, Generaal E, et al. Exercise interventions for the prevention of depression: a systematic review of meta-analyses. *BMC Public Health*. 2020;20(1):1255. doi:10.1186/s12889-020-09323-y

7. Jacobson NC, Weingarden H, Wilhelm S. Using Digital Phenotyping to Accurately Detect Depression Severity. *J Nerv Ment Dis*. 2019;207(10):893-896. doi:10.1097/NMD.0000000000001042

8. Moshe I, Terhorst Y, Opoku Asare K, et al. Predicting Symptoms of Depression and Anxiety Using Smartphone and Wearable Data. *Front Psychiatry*. 2021;12:625247. doi:10.3389/fpsyt.2021.625247

9. Pearce M, Garcia L, Abbas A, et al. Association Between Physical Activity and Risk of Depression: A Systematic Review and Meta-analysis. *JAMA Psychiatry*. 2022;79(6):550. doi:10.1001/jamapsychiatry.2022.0609

10. Li L, Zhang Q, Zhu L, et al. Screen time and depression risk: A meta-analysis of cohort studies. *Front Psychiatry*. 2022;13:1058572. doi:10.3389/fpsyt.2022.1058572

11. Santos RMS, Mendes CG, Sen Bressani GY, et al. The associations between screen time and mental health in adolescents: a systematic review. *BMC Psychol*. 2023;11(1):127. doi:10.1186/s40359-023-01166-7

12. Boers E, Afzali MH, Newton N, Conrod P. Association of Screen Time and Depression in Adolescence. *JAMA Pediatr*. 2019;173(9):853. doi:10.1001/jamapediatrics.2019.1759

13. Chaput JP, Dutil C, Featherstone R, et al. Sleep duration and health in adults: an overview of systematic reviews. *Appl Physiol Nutr Metab*. 2020;45(10 (Suppl. 2)):S218-S231. doi:10.1139/apnm-2020-0034

14. Fang Y, Forger DB, Frank E, Sen S, Goldstein C. Day-to-day variability in sleep parameters and depression risk: a prospective cohort study of training physicians. *Npj Digit Med*. 2021;4(1):28. doi:10.1038/s41746-021-00400-z

15. Li J, Cao D, Huang Y, et al. Sleep duration and health outcomes: an umbrella review. *Sleep Breath*. 2022;26(3):1479-1501. doi:10.1007/s11325-021-02458-1

16. Aledavood T, Torous J, Triana Hoyos AM, Naslund JA, Onnela JP, Keshavan M. Smartphone-Based Tracking of Sleep in Depression, Anxiety, and Psychotic Disorders. *Curr Psychiatry Rep*. 2019;21(7):49. doi:10.1007/s11920-019-1043-y

17. Wu A, Scult MA, Barnes ED, Betancourt JA, Falk A, Gunning FM. Smartphone apps for depression and anxiety: a systematic review and meta-analysis of techniques to increase engagement. *Npj Digit Med*. 2021;4(1):20. doi:10.1038/s41746-021-00386-8