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Abstract

Concept study: Genetic markers of biological age as study endpoints of eHealth interventions Promoting Lifestyle Change

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a. Background and Objective

Mobile health (mHealth) apps can potentially support patients and health care systems. A study of the use of markers of biological age (methylation clocks) to follow and document the adherence and the effects of mHealth lifestyle interventions (digital Coach (Chatbot)) is planned. The cause-and-effect connection between changes in DNA methylation and lifestyle changes is unknown. The adherence of study subjects to lifestyle interventions also needs to be evaluated. The main objective of this contribution is to discuss a realistic study design.

b. Methods

A smartphone-based and chatbot-delivered intervention designed for a large-scale population will be adapted for optimal use in European countries. The following data will be collected: vital parameters, serum samples, and stool samples. Epigenetic (biological) age (GrimAge) will be determined from saliva and blood cells. The metabolome of the blood samples (250 metabolites (NMR von Nightingale (Helsinki))) will be determined, too. The adherence of the intervention group will be analyzed continuously.

c. Results

A pilot study is conceived to allow estimates of the effects of the intervention on epigenetic age and several other health- and age-associated biomarkers. A study group and an age- and sex-matched control group will be recruited. The statistical power will depend on the size of the study groups and the duration of the study, as well as the size of the expected effects.

d. Conclusion

For an expected decrease of 1 year of biological age as determined by GrimAge, the calculated power estimation recommends a study size of 100 subjects both in the study and in the control group.

Genetic Markers of Biological Age in Multi-component Lifestyle Interventions: Results of a Preliminary Literature Search

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Motivation

Mobile health (mHealth) apps can potentially support patients and health care systems (Jakob et al. 2022). Of particular interest is the application of mHealth apps to multi-component lifestyle interventions, such as diet and nutrition, physical activity, sleep and stress management behavior. Such interventions have the potential to slow down or even revert aging processes (Fiorito et al. 2021). Many clinical and laboratory biomarkers have been evaluated to document the aging process and healthy aging (Li et al. 2021). Popular markers are telomere length and epigenetic methylation clocks (Seale et al. 2022). Studies evaluating epigenetic clocks as biomarkers have yielded inconclusive results (Galow & Peleg 2022).

We plan to study the effects of a mHealth intervention on epigenetic clocks as biomarkers of healthy aging. A preliminary literature search was conducted to inform the design of such an intervention.

Method

A preliminary literature search was conducted that will inform a scoping review. For this purpose, the PubMed and Google Scholar databases were used with the following search terms: lifestyle intervention, epigenetic clock, and aging biomarker.

Preliminary Results

Number of studies	34
Epigenetic clocks	6
Telomere Length	17
Only telomere published	15
Digital Tools (DT)	2
functions of DT	3
delivery channels of DT	2
only published age clocks	6

Future Work

As a next step, the scoping review will be finalized. The results will inform the design of a smartphone-based and chatbot-delivered multi-component intervention and the sample size of a randomized controlled trial (RCT). The following data will be collected at the beginning and after the intervention, as well as during a 6-month follow-up of the RCT: vital parameters, serum samples, and stool samples. Epigenetic (biological) age (GrimAge/TruAge) will be determined from saliva and blood cells at the beginning and the end of the intervention, as well as during the follow-up. The metabolome of the blood samples (250 metabolites (NMR von Nightingale (Helsinki); Würtz et al. 2017)) will be determined, too. Adherence to the intervention will be measured continuously via the mHealth app.

References

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Summary of Results

Published and registered studies

	N	
Physical activity	13	38%
Diet	13	38%
Supplements	5	15%
Mental health exercises	6	18%
Sleep	3	9%
Combination of ICs	8	24%

	N	
Published RTCs	25	74%
Registered RTCs	5	15%

Biological age biomarkers

	N	
Epigenetic age clocks	9	26%
DNAm changes in local cells/tissues	1	3%
Telomere length	17	50%
Visible aging biomarkers	2	6%

Epigenetic age clocks, only published studies

	N	
Horvath's DNAmAge clock	3	50%
DNAmGrimAge	1	17%
Hannum's DNAm clock	1	17%
Zbiec´-Piekarska's DNAmAge clock	1	17%
Own clok based on CpGs	1	17%
Test tool / Method	N	
Illumina Methylation 450K	5	83%
PyroMark Q48 Autoprep	1	17%

Telomere length, only published studies

Type of measurement	N	
Average Telomere length	15	100%
% change of short telomeres	1	7%
Test tool / Method	N	
qPCR	14	93%
Telo TAGGG TL assay kits	1	7%

Significance of results

	N	
Physical activity	7	54%
Diet	8	62%
Supplements	2	40%
Mental health exercises	3	50%
Sleep	1	33%
Combination of ICs	4	50%
Total interventions	14	100%
Biomarker of biological age		
Epigenetic age clocks	4	67%
Telomere length	7	41%

Treatment protocol with Digital Tool (DT)

Digital tool	N	
Treatment protocol with DT	1	17%

Specific Digital Tools

Specific digital tools	N	
MBody360	1	50%
Triaxial accelerometry	1	50%

Functions of DT

Specific functions of DT used	N	
Meal planning/shopping lists/recipes	1	33%
Communication with coach	1	33%
Recordings of PA and sleep info.	1	33%

Delivery channels of DT

Specific delivery channels of DT used	N	
App for smartphones & computers	2	100%
App for smartphones	0	0%
App for computers	0	0%