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Promotion of physical activity-related health competence using digital workplace-based health promotion: protocol for a controlled before-and-after study

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ABSTRACT

Physical activity (PA) has a high potential to prevent chronic diseases. At the same time, many people in Germany do not achieve PA recommendations due to trends such as digitalisation and the COVID-19 pandemic and, as a result, working from home. There is a need for location-independent and time-independent interventions. Based on the model of physical activity-related health competence (PAHCO), a study design was developed for a digitally conducted, controlled, before-and-after-study targeting office workers. The intervention group receives video-based instructions with exercises that can be performed directly at the desk, complemented by anatomical explanations and advice on PA based on the PAHCO model. The control group only receives the exercises. The intervention period is 5 weeks. Follow-up is conducted after 3 months. The trial shall comprise 294 participants per group whose PA is recorded via questionnaire and online PA diary. Their PAHCO and health-related quality of life are also assessed.

The present study aims to increase the health-enhancing PA of office workers independent of time and location. Trial registration number is DRKS00028053.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Physical activity (PA) has positive effects on health.
⇒ Many people do not meet PA recommendations.

WHAT THIS STUDY ADDS

⇒ This study tests whether the health-enhancing physical activity (HEPA) of office workers can be increased through short exercise videos that contain aspects of PA-related health competence.

HOW MIGHT THIS STUDY AFFECT RESEARCH, PRACTICE OR POLICY

⇒ This would provide a short, location-independent and time-independent way to increase HEPA.

INTRODUCTION

There is clear evidence for the health-promoting effects of physical activity (PA) in preventing chronic diseases such as stroke, hypertension, colon and breast cancers, type 2 diabetes and cardiovascular disease[1 2] and in therapy.[3] Due to these effects, PA as a behaviour can be attributed to a positive quality called health-enhancing physical activity (HEPA). This evidence has led to many national[4 5] and international[6] PA guidelines. The WHO recommends at least 150 min of moderate or 75 min of vigorous PA per week for healthy adults (leisure time, exercise at work, home or sport), in combination with activities that strengthen the major muscle groups on at least 2 days per week.[6] Additional health benefits can be obtained from flexibility and neuromotor exercises.[7]

However, the GEDA survey (Gesundheit in Deutschland aktuell),[8] the representative health monitoring for Germany, shows that only 42.6% of women and 48% of men achieve WHO recommendations; 27.6% of women and 31.2% of men do muscle-strengthening exercises at least 2 days a week, and only one in five woman and one in four man follows both recommendations.

Germany is not the only country where people do not act on the various and widespread information on PA. Due to its tremendous impact on the respective healthcare system, the promotion of PA has also been anchored at the political level worldwide: in the 'global action plan on physical activity',[9] the WHO stated the goal of reducing the prevalence of physical inactivity worldwide by 15%.

In addition to physical inactivity, prolonged sitting is a risk factor for chronic diseases.[6] Long periods in a sitting position lead to an increased risk of chronic diseases and an increased mortality rate from all causes and by cardiovascular disease, which seemed to be

independent of PA for a long time.[10 11] Recent studies show that the risks of prolonged sitting can be increased by 30–40 min of moderate PA per day.[12] However, prolonged sitting is part of many people's everyday lives: on average, adults in Germany sit for 8.5 hours a day, one of the main influencing factors being work with an average of 3 hours of sitting time.[13]

Current trends, such as the digitalisation of work and the COVID-19 pandemic, as well as working from home as a result of both, contribute to the fact that many people do not succeed in reaching the recommendations for PA. Due to restrictions caused by the COVID-19 pandemic (eg, quarantine, closed gyms and bans on doing outdoor activities in the park), self-reported PA has decreased in many countries, in some cases by up to 40%.[14 15]

There is a broad discussion about the reasons for too little PA—from lack of knowledge to lack of motivation, volition or environmental conditions at work and leisure time that is not suitable for PA.[16–19] One attempt to deal with this is to motivate people to become more active in their working environment because the workplace is a relevant setting for many people, and they spend a lot of time here. Observational studies showed the 'physical activity paradox', according to which leisure time PA positively affects health. In contrast, high occupational, PA negatively affects health (eg, due to too low intensity, too long duration or low worker control).[20 21] However, interventional studies do not yet allow a clear conclusion as to whether the promotion of PA at the workplace positively affects employees' health.[4 22 23]

Office workers as the target group are highly relevant in this context, as they are particularly affected by digitalisation and work in the home office. A high proportion of them move (too) little and spend long periods of working time sedentary.[24 25]

The model of physical activity-related health competence (PAHCO) is the theoretical framework for developing the present intervention.[16 26 27] This model contains the three subcompetences of movement competence, control competence and self-regulation competence. Movement competence includes the motor abilities and skills to perform physical activities. Control competence describes the ability to make correct decisions as an individual regarding the amount and intensity of PA to improve one's own biopsychosocial health. Moreover, self-regulation competence describes the volitional and motivational abilities to ensure PA. It is important to address all three subcompetencies simultaneously at the three levels of 'physical exercise', 'learning' and 'experience' to connect what is learnt with movement practice and (positive) experiences and thus holistically promote PAHCO.[16 26]

The PAHCO model is set at the interface between physical and health literacy. Physical literacy sets the goal to be physically active for the whole life but sees health only as one of six potential forms of movement. Because of the shared outcome of health, health literacy seems to be more related to PAHCO, but the PA itself and the motivational and volitional aspects are underemphasised.[16] However, there are links to the health literacy model by Nutbeam[28]: with well-developed PAHCO, it can be assumed that an individual can find information on HEPA, understand it, critically evaluate it and, above all, apply it.[16]

Blaschke *et al*[29] have already analysed office workers' leisure time PA in connection with PAHCO in a study and found a strong positive association. However, the entire PAHCO questionnaire has not yet been used in this study. Also, leisure time PA was surveyed, not HEPA, which is the conceptual outcome of the PAHCO model.

The study described here aims to investigate the relationship between PAHCO and HEPA of office workers in an intervention and a control group to gain further insights into this topic and to describe the influence of PAHCO on HEPA more precisely. In addition, the control group design allows to investigate the effects of the intervention on PAHCO and HEPA. Therefore, the overall research question of the study is: what is the impact of promoting PAHCO in a digital, PA intervention on HEPA?

Study design

The study is designed as a controlled before-and-after study to promote HEPA over 5 weeks for people who work mainly in a sitting position. The aim is to sustainably increase their HEPA to reduce the risk of chronic diseases in medium and long terms. The intervention will be developed based on the PAHCO model. It is hypothesised that the HEPA of the intervention group differs significantly from the control group after the intervention. Additionally, we assume that the PAHCO dimension control competence will be increased in the control group due to the high amount of action knowledge and effect knowledge in the videos.

Patient and public involvement

There was no patient or public involvement in the design of the study.

Inclusion and exclusion

All genders are going to be included in the study. The target group are people between 18 years and 67 years, with the main job being predominantly sedentary. Participants will be excluded if they are incapable of giving consent, are pregnant, have had surgery 6 weeks before the start of the study or are not allowed to exercise due to a doctor's prescription. These criteria will be queried before inclusion in the study at the first measurement point (before the start of the intervention (T0); see figure 1 for details on the implementation of the trial).

Recruitment and allocation to groups

The study will be conducted from September 2022 to January 2023 in cooperation with two companies from the financial sector in the Hannover region (Lower Saxony, Germany), whose employees are mainly working sedentary at their desks. Due to the workplace-based

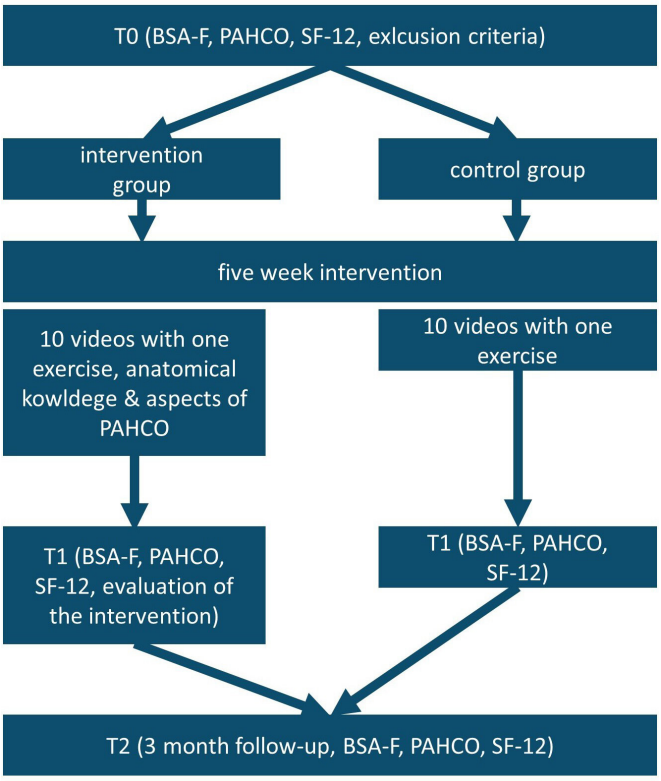

Figure 1 Implementation of the trial. BSA-F, Bewegungs und Sportaktivität Fragebogen; PAHCO, physical activity-related health competence; SF-12, Short Form 12 Health Survey.

design and the potential need for cluster randomisation and thus more participants to retain sufficient power, randomisation of participants is not possible, so the study will be conducted as a controlled before-and-after study with one company as an intervention group and another as a control group.

Intervention description

Both groups will receive 2 weekly videos via email explaining an exercise that can be done directly at the individual desk. The first exercise per week is the same for all participants. For the second, they can choose between two exercises to adapt the intervention to their needs.

The exercises are deliberately chosen to be manageable for all participants in their basic variant and easy to learn. For all exercises, however, optional variations are given that are more challenging so that the participants can improve throughout the intervention. The exercises target different body areas, but one focus is on strengthening and stretching the shoulder and neck muscles, as these areas are particularly strained when sitting.[30]

Examples of the exercises are sit-ups to strengthen the abdominal muscles while sitting on a chair, reverse butterflies with water bottles in the hands to strengthen the shoulder and neck muscles, or an exercise to stretch the chest, shoulder and neck muscles (see online supplemental material 1 for all exercises). Over 5 weeks of intervention, participants will receive 10 exercises. All exercise videos remain accessible over the study period.

In the videos for the intervention group, the exercise is briefly shown, and then the muscles involved and their function are explained using anatomical drawings. This is followed by a step-by-step explanation of the exercises, advice on the number of repetitions and frequency of training, as well as showing alternatives (eg, sit-ups on the floor, reverse butterflies while standing and bouncing in the final position of the stretch). A section follows this in the video that explains a specific aspect of the model of PAHCO (eg, 'What is strength training? How do I assess my sense of exertion? What influence do muscles have on posture?'). For explanation, short video sequences, animated clips and practical examples are part of the intervention. The videos last about 5 min.

Inspired by the model of PAHCO, the participants are encouraged to reflect on the intensity of the exercise, the number of repetitions and the frequency of training and to put them together according to their preferences to remain active in a health-promoting way independently even after the end of the study.

The PAHCO model assumes that the three levels of physical exercise, learning and experience should be addressed simultaneously in a training session to increase PAHCO.[26 31] The level of physical exercise is conveyed through the exercise via the visualisation and step-by-step explanation. The learning aspect is covered by the accompanying explanations of the muscles involved and their function in everyday life and the specific aspects of PAHCO. The PAHCO aspects also play a role in the experience. In the videos is shown that PA is also suitable for affect regulation. Corresponding exercises, for example, to distract oneself from work for a moment and afterwards to refocus better, are shown. The participants can try them out immediately and experience these effects.

In addition, a reflection task is added here, which encourages the participants to relate the aspect to the exercise presented in the video and to their everyday life. For example, when the videos explain good posture at the desk, the participants can immediately try out these tips and notice how their posture changes.

The control group receives the same exercises, but contrary to the intervention group, they only see the exercise and receive explanations. Instructions include the number of repetitions and how often to do them. Moreover, alternatives are shown, but parts on anatomy and aspects of PAHCO are missing in these videos. The intervention thus primarily addresses the physical level of health-enhancing exercise, but knowledge and motivation aspects are less focused on. These videos last about 2 min.

In addition to the videos, once a day, all participants receive an email to remind them about the videos and motivate them at the same time to take a short exercise break. The emails refer to the current exercise video and contain a link to a PA diary to fill in the PA of the previous day. Participants can choose at T0 whether they prefer to

receive the reminder in the morning, at noon or in the afternoon. For further information on the study design, see online supplemental material 2 for the Consensus on Exercise Reporting Template checklist.[32]

Measurements

There will be three measurements throughout the study: T0, directly after the intervention (T1) and follow-up after 3 months (T2). Standardised questionnaires are used at all three measurement points: The Bewegungs und Sportaktivität Fragebogen (BSA-F) for recording PA,[33] the PAHCO questionnaire[34] and the Short Form 12 Health Survey (SF-12) questionnaire on health status.[35] During the intervention, the participants are asked to keep an online PA diary. All surveys take place online.

Primary outcomes

In terms of self-monitoring,[18] the participants are asked to keep a diary of their PA for the duration of the intervention to document the type, duration and intensity of PA and to record their progress. This allows during evaluation the subsequent calculation of metabolic equivalent of task (MET) minutes and thus estimation of the HEPA of the participants. One MET is the amount of energy an average adult spends while sitting quietly. More intense activities require several times more METs.[36] For example, riding a bicycle slowly to work is given as 4.0 METs, playing tennis as 7.3 and rope skipping as 12.3.[37] For evaluation, the appropriate METs according to Ainsworth[37] are assigned to the given activities, multiplied by the duration of the activity and added weekly to obtain the weekly MET minutes. Activities with less than 3 METs have too little intensity, so they are excluded as they do not count as HEPA.[6] Walking will be included with the weighting factor 0.5 to not overestimate the effects.[38] The diary thus serves to record the main outcome, but at the same time, it can also support the effectiveness of the intervention.[39] The structure of the PA diary is based on the BSA-F[33] and has lines for three possible physical activities per day, plus the subjective load on the Borg scale[40] and the duration of the activity. In addition, there is space for own thoughts concerning PA.

The BSA-F[33] was developed to measure self-reported PA with a short, flexible questionnaire and a clear structure. It is divided into three parts: the first part measures physical activity at work (three items); the second part measures PA during leisure time (eight items); and the third part measures sports activity (two items). For the parts on PA in leisure time and sports activity, an index can be formed in the unit minutes per week. The reference period covered by the questionnaire is the last 4 weeks, but it can be adjusted. The BSA-F was validated with the help of bicycle ergometric performance diagnostics; correlations of r=0.32 with maximum oxygen uptake and r=0.34 with the individual anaerobic threshold were found. The BSA-F has already been used in many studies, including those addressing PAHCO[41–43] or promoting PA in the workplace.[44]

The minutes per week index will be evaluated, and MET minutes will be calculated in the same way as in the PA diary.

HEPA is recorded in these two ways, as it can be assumed that the data from the PA diary is more accurate because it is collected directly on the day after the activity. On the other hand, there will probably be more missing data because not all participants remember to fill in the PA diary daily. Primarily, the difference in HEPA at T0 and T1 will be compared for the longer-term effects and the development at T2.

Secondary outcomes

The PAHCO questionnaire[34] measures the three subcompetences of PAHCO via 10 scales with 42 items in total. The evaluation can be carried out on individual scales or the subcompetency level via sum, mean value or percentage scales. The validation was carried out in two studies from rehabilitation (patients with chronic obstructive pulmonary disease (COPD)) and prevention (apprentices in nursing care and automotive mechatronics) with the help of PA and health and showed satisfactory results, according to the authors. The questionnaire or parts of the questionnaire have already been used in studies with students,[27 34] apprentices,[41] patients with COPD,[45] pupils[42] and office workers.[29]

The SF-12 is the short form of the SF-36 questionnaire on health status. It includes the dimensions of general health perception, pain, vitality, social functioning, psychological well-being, physical functioning, physical role functioning and emotional role functioning.[35] The short form still has 80% of the precision of the long form and is therefore suitable for assessing the quality of life of the respondents with a low expenditure of time.[46] It has been validated in many studies and is one of the standard instruments for assessing health-related quality of life.[47] The SF-12 has also already been used in the context of PAHCO.[29 41 43]

At T1, the individual intervention components (structure and content of the videos, PA diary and intervention homepage) are also evaluated, including questions about how many videos the participants have watched. In this way, the acceptance of the intervention and its effectiveness in relation to its use can be ascertained.

STATISTICS

Sample size

Currently, no intervention studies focus on PAHCO in a similar target group. Various meta-analyses show effect sizes between d=0.14,[39] d=0.21[48] and d=0.34[49] for theory-based, PA-based health promotion programmes.

However, no precise effect size estimate can be derived from these preliminary results since the theoretical approach, study group and delivery medium have not yet been tested in this combination. Therefore, a mean value of the studies mentioned previously for the effect size of d=0.23 with a power of 80% and a significance level of 0.05 is used as an alternative to calculate the sample

size. Accordingly, 235 persons per group have to participate. With an expected dropout rate of 20% from similar studies, 294 subjects per group should be included at the beginning of the study, that is, a total of 588 (calculations with G*Power V.3.1.9.6).[50]

Data analysis

Our goal is to examine how HEPA differs between the intervention and the control group after the intervention. To test this, repeated measures analyses of covariance are conducted for the METs from the PA diaries and for the BSA-F at all measurement points, controlled for demographics, and if the normal distribution does not apply, the non-parametric alternatives are used. We will use Mauchly's sphericity test and corresponding corrections in case of sphericity violations. Levene's test will control for homogeneity of variances. To analyse significant differences between pairs of means in the analysis of variance, we will use post hoc tests with Bonferroni correction. The significance level is set at 0.05 for all tests.

Furthermore, correlations with health-related quality of life and the use of the intervention will be considered, as well as questions on the assessment of the videos and satisfaction with the intervention content. All analyses will be conducted using IBM SPSS Statistics V.28 software.

DISCUSSION

In this controlled before-and-after-study, the intervention group will receive short exercise videos supplemented with aspects of PAHCO and functional anatomy. The control group will receive the exercise videos only. The aim is to investigate how HEPA differs after the intervention.

The PAHCO model has recently been used in many settings,[51] including office workers.[29] However, intervention studies with this model as a theoretical basis are only available for people with intellectual disability[52] and pupils.[53] Both interventions took place in an institutionalised way. In the school setting, six sports lessons of 90 min each could be used, and the intervention for people with intellectual disabilities was carried out in cooperation with the provider of the inpatient residential care of the participants.[54] In a working context, on the other hand, a relatively short, time-independent and location-independent intervention seems recommendable because it reaches participants independently of a home office, meetings and other appointments. Recently, this has especially been discussed in the context of digital occupational health management.[55] Our intervention can be classified as a part of occupational health promotion, a subarea of occupational health management. This includes measures of prevention and health promotion in the workplace context.[56]

The intervention presented here is primarily preventive at the behavioural level and includes health-promoting aspects. However, the promotion of PAHCO is a factor that goes beyond plain PA offers: in the theory, it is postulated that PAHCO may be increased through interventions and stays stable over time.[42] These effects could help not only to increase HEPA in the work context but also to transfer it in other life contexts. This also addresses the problem of the PA paradox[20]: in the present study, the participants' PA is promoted at the workplace. Still, in a health-promoting way and by applying the PAHCO model, it can be assumed that the intervention impacts the overall lifestyle of the participants.

Strengths and limitations

To the best of our knowledge, this is the first study to examine PAHCO and HEPA of office workers. In a previous study, Blaschke *et al*[29] found a correlation between PAHCO and leisure time PA in this target group but also stated that the survey of HEPA is recommended due to conceptual differences in leisure time PA.

The present study also complies with the recommendation for intervention studies in general by Carl[51] and specifically for office workers by Blaschke *et al*[29] to examine a possible causal relationship between PAHCO and PA.

Previous interventions to promote PA in the workplace are often more formalised and based on a fixed course structure with longer sessions (eg, 3×50 min of yoga per week, 2 hours of fitness training in leisure time, 30–60 min of fitness training once a week, weekly yoga and fitness classes[23]), which take place at a fixed time in a fixed place. However, new challenges for the working environment, such as digitalisation, working from home and the COVID-19 pandemic, require interventions independent of location and time.

There are also several limitations to this study. The greatest limitation is that it is not possible to randomise the participants. Due to the workplace-based design in cooperation with companies, the participants would have had to be cluster-randomised to avoid spill-over effects, leading to a significantly higher number of participants to achieve sufficient power.

Another limitation is that the intervention period is 5 weeks, a relatively short period for PA interventions in the workplace.[23] However, to test the effects of the intervention, the duration seems acceptable.

Furthermore, PA is not measured objectively but self-reported through a PA diary and a questionnaire, which are not as accurate as objectively measured due to aspects such as social desirability and the retrospective form of the survey.

CONCLUSION

Office workers are particularly affected by work-specific challenges that can lead to low PA levels. To increase PA at work and support them in leading a healthy, physically active lifestyle, the present digital, location-independent and time-independent intervention is developed to strengthen HEPA through PAHCO. It can help specify the relationship between PAHCO and HEPA in office workers and develop future interventions.

Contributors LO and M-LD designed the study. LO drafted the manuscript. All authors critically revised the manuscript, gave the final approval and agreed to be accountable for all aspects of the work, ensuring integrity and accuracy.

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Competing interests None declared.

Patient and public involvement Patients and/or the public were not involved in the design, conduct, reporting or dissemination plans of this research.

Patient consent for publication Not applicable.

Ethics approval This study involves human participants and was approved by Hannover Medical School Ethics Committee (Nr. 10157_BO_K_2022). The participants gave informed consent to participate in the study before taking part. The study results will be published in peer-reviewed public health and sports and exercise medicine journals and will be part of a doctoral thesis.

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