



## Registration E-class materials and Outline.

### Exercise psychology and health education II (PE\_P\_167)

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## The psychology of exercise for the clinical population

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## Review questions

- Relationships between exercise and health
- Reasons for the clinical population to increase exercise
- Strategies for the clinical population to increase exercise
- Recommended types and forms of exercise for healthy and clinical populations
- **New roles for exercise psychologists?**
- **Let's think as exercise specialists**

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- In recent years, large-scale evidence-based research has shown that inactivity is one of the main risk factors for mortality from non-communicable diseases, which has been recognised by the World Health Organisation.
- People who are not sufficiently physically active have an increased risk of death by 20% to 30% compared to those who exercise adequately (WHO, 2024a).
- Statistics show that nearly a third (31%) of adults worldwide, or about 1.8 billion people, did not meet recommended levels of physical activity in 2022. These findings demonstrate a worrying trend of increasing inactivity in adults, which has increased by approximately 5 percentage points from 2010 to 2022 (WHO, 2024b).
- In terms of the relationship between physical activity and specific diseases, data show that regular physical activity reduces the risk of many types of cancer by 8% to 28%, heart disease and stroke by 19%, diabetes by 17%, and depression and dementia by 28% to 32%, according to the World Health Organization.
- In a recent report, it warned that a lack of physical activity could lead to nearly 500 million new cases of non-communicable diseases and premature deaths by 2030, while these cases could be prevented (WHO, 2022a). In addition, it is estimated that up to 5 million deaths per year could be prevented if the population were more physically active worldwide (Xu et al., 2022).

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- The problem of inactivity has also been evaluated from its economic dimension. A large economic study estimated the direct costs of public healthcare, using the most recent available health and economic data from 194 countries. The findings show that by 2030, about 499.2 million new cases of non-communicable diseases due to inactivity are expected to occur worldwide. These incidents could be prevented if effective ways are found to combat inactivity. The direct cost of healthcare globally is expected to reach \$520 billion by 2030, or \$47.6 billion annually. Of these expenses, dementia management accounts for 22%, diabetes 9%, and cancer 15% (Santos et al., 2023).
- Participation in physical activities and exercise programs reduces premature mortality levels and increases life expectancy by 2 to 4 years. Increasing moderate or vigorous intensity physical activity from 10 to 20 or 30 minutes per day is associated with a reduction in mortality by 6.9%, 13.0%, and 16.9% respectively (Saint-Maurice et al., 2022). Research conducted on a large number of adults recorded lower levels of mortality in people who exercised between 150 and 300 minutes per week. Those who exercised between 300 and 600 minutes of moderate or vigorous exercise had the best results (Lee et al., 2022).

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## Topics

- Exercise and health
- Exercise for the clinical population
- Psychological effects of exercise on a clinical population
- Practical implication
- General results
- Recommendations

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## introduction

- Regular physical activity is one of the most important things you can do for your health. It can help:
- [Control your weight](#)
- [Reduce your risk of cardiovascular disease](#)
- [Reduce your risk for type 2 diabetes and metabolic syndrome](#)
- [Reduce your risk of some cancers](#)
- [Strengthen your bones and muscles](#)
- [Improve your mental health and mood](#)
- [Improve your ability to do daily activities and prevent falls, if you're an older adult](#)
- [Increase your chances of living longer](#)

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## WHO 2020

- **How much of physical activity is recommended?**
- **Children and adolescents aged 5-17 years**
- Should do at least 60 minutes of moderate to vigorous-intensity physical activity daily.
- Physical activity of amounts greater than 60 minutes daily will provide additional health benefits.
- Should include activities that strengthen muscle and bone, at least 3 times per week.
- **Adults should do at least 150 minutes to 300 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 to 150 minutes of vigorous intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity for substantial health benefits.**
- **Adults should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits.** **Strong recommendation, moderate quality evidence** Adults may increase moderate intensity aerobic physical activity to more than 300 minutes per week, or engage in more than 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous-intensity activity, for additional health benefits.
- **All older adults should undertake regular physical activity.**
- **Older adults should do at least 150 minutes to 300 minutes of moderate-intensity aerobic physical activity throughout the week, or do at least 75 to 150 minutes of vigorous-intensity aerobic physical activity throughout the week, or an equivalent combination of moderate- and vigorous-intensity activity for substantial health benefits;**
- **Older adults should also do muscle-strengthening activities at moderate or greater intensity that involve all major muscle groups on 2 or more days a week, as these provide additional health benefits;** As part of their weekly physical activity, older adults should do varied multicomponent physical activity that emphasises functional balance and strength training at moderate or greater intensity on 3 or more days per week to enhance functional capacity and prevent falls. **Older adults may increase moderate-intensity aerobic physical activity to more than 300 minutes per week, or engage in more than 150 minutes of vigorous-intensity aerobic physical activity per week, or an equivalent combination of moderate- and vigorous intensity activity, for additional health benefits.**

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## Exercise as medicine – evidence for prescribing exercise as therapy in 26 different chronic diseases

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This review provides the reader with the up-to-date evidence-based basis for prescribing exercise as medicine in the treatment of 26 different chronic diseases: psychiatric diseases (depression, anxiety, stress, schizophrenia); neurological diseases (Alzheimer's disease, Parkinson's disease, multiple sclerosis, metabolic diseases (diabetes, hyperlipidemia, metabolic syndrome, pre-diabetes, type 2 diabetes, type 1 diabetes, cardiovascular diseases (hypertension, coronary heart disease, heart failure, cerebral vasculature), and

classification (asthma, pulmonary diseases (chronic obstructive pulmonary disease, asthma, cystic fibrosis); musculoskeletal disorders (osteoarthritis, osteoporosis, back pain, rheumatoid arthritis and cancer). The effect of exercise therapy on disease pathogenesis and response are given and the possible mechanisms of action are discussed. We have integrated the scientific literature and for each disease, we provide the reader with our best advice regarding the optimal type and dose for prescription of exercise.

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## Quantity and Quality of Exercise for Developing and Maintaining Cardiorespiratory, Musculoskeletal, and Neuromotor Fitness in Apparently Healthy Adults:

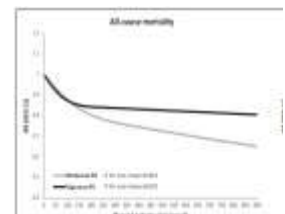
1. The ACSM recommends that most adults engage in moderate-intensity exercise training for 150 min/wk,  $\geq 30$  min/d on  $\geq 5$  d/wk for a total of  $\geq$  vigorous-intensity cardiorespiratory exercise training for  $\geq 20$  min/d on  $\geq 3$  d/wk ( $\geq 75$  min/wk), or a combination of moderate- and vigorous-intensity exercise to achieve a total energy expenditure of  $\geq 500$ –1000 MET/min/wk.
2. Behaviorally based exercise interventions, the use of behavior change strategies, supervision by an experienced fitness instructor, and exercise that is pleasant and enjoyable can improve adoption and adherence to prescribed exercise programs.

Cardiac Exercise Guidelines, American College of Sports Medicine, 2010. Available from: <http://www.acsm.org/docs/default-source/exercise-guidelines/exercise-guidelines-for-prescribing-exercise.pdf?sfvrsn=1>

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## Association between long-term leisure-time physical activity intensity and all-cause and cause-specific mortality. (Circulation 2022)

- A total of 116 221 adults
- The nearly maximum association with lower mortality was achieved by performing  $\approx 150$  to 300 min/wk of long-term leisure-time VPA, 300 to 600 min/wk of long-term leisure-time MPA, or an equivalent combination of both.



Long Term Leisure-Time Physical Activity Intensity and All-Cause and Cause-Specific Mortality: Prospective Cohort Study. *Circulation*. 2022;145(10):e122222. doi:10.1161/CIRCULATION.122.222222

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## Exercise for clinical population

Exercise can be good for anxious, depressed, clinical, addicted, ect populations



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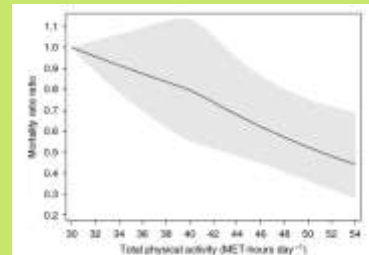
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## Exercise, diseases and life expectancy

- 416,175 individuals participated in Taiwan between 1996 and 2008, with an average follow-up of 8.05 years (Lancet 2011)
- Compared with individuals in the inactive group, those in the low-volume activity group, who exercised for an average of 92 min per week, or 15 min a day, had a 14% reduced risk of all-cause mortality, and had a 3 year longer life expectancy.
- Interpretation 15 min a day or 90 min a week of moderate-intensity exercise might be of benefit, even for individuals at risk of cardiovascular disease.
- Chi-Pang Wen\*, Jackson Pui-Man Wan\*, Min Kuang Tsai, Yi-Chen Yang, Ting-Yuan David Cheng, Meng-Chih Lee, Hui-Ting Chan, Chuen-Keng Tsao, Shan-Pou Tsai, Xifeng Wu (2011). Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. *Lancet* 2011; 378: 1244–53. DOI:10.1016/S0140-6736(11)60749-6.

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## Mortality and exercise



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## Some general results

(ACSM, 2011).

- According to the sport science literature and research evidence,
- the application of psychological and physiological principles of exercise to clinical populations is of great importance **since quality of life** is a significant outcome derived from long-term adherence to exercise.
- All-cause mortality is delayed by regular engagement in physical activity

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## The effect of physical activity on health is associated

- with greater resistance to chronic illnesses,
- weight control and protection,
- prevention or even improvement of diseases such as
- heart related conditions,
- hypertension,
- osteoporosis,
- diabetes,
- back pain,
- respiratory and musculoskeletal problems,
- metabolic and neurological disorders,
- cancer,
- depression etc. (Dishman et al., 2006).

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## Effects of exercise in breast cancer survivors:

- A small to moderate positive effect of physical activity during treatment was seen for physical activity level, aerobic fitness, muscular strength, **functional quality of life, anxiety, and self-esteem**.
- With few exceptions, exercise was well tolerated during and post treatment without adverse events.
- Current evidence suggests many health benefits from physical activity during and post cancer treatments.

- An update of controlled physical activity trials in cancer survivors: A systematic review and meta-analysis  
Speck, B.M.\*; Gaeremynck, K.S.\*; Miles, L.C.\*; Dool, S.\*; Schmitz, K.J.\*

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Question Does vigorous intermittent lifestyle physical activity (VILPA) in short bouts (1 and 2 minutes) have a dose-response association with incident cancer among nonexercising adults?

Findings In this prospective cohort study of 22,398 self-reported nonexercising adults, a minimum dose of 3.4 to 3.6 minutes of VILPA per day was associated with a 17% to 18% reduction in total incident cancer risk compared with no VILPA. A median daily VILPA of 4.5 minutes was associated with a 31% to 32% reduction in physical activity-related cancer incidence. The findings of this large cohort study suggest that 3 to 4 minutes of VILPA per day may be associated with decreased cancer incidence risk; thus, VILPA may be a promising intervention for cancer prevention among individuals unable or unmotivated to exercise in leisure time.

Li, Q., Pan, X., Li, X., & Huang, W. (2022). Association of Physical Activity Intensity with All-Cause Mortality in Cancer Survivors: A National Prospective Cohort Study. *Cancers*, 14(28). <https://doi.org/10.3390/cancers14282828>



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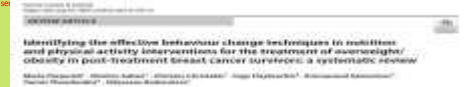
## Exercise for cancer survivors, ACSM, 2019

- Overall findings reinforced the conclusions that exercise training and testing were generally safe for cancer survivors and that every survivor should “avoid inactivity.” Enough evidence was available to conclude that specific doses of aerobic, combine aerobic plus resistance training, and/or resistance training could improve common cancer-related health outcomes, including anxiety, depressive symptoms, fatigue, physical functioning, and health-related quality of life. Implications for other outcomes, such as peripheral neuropathy and cognitive functioning, remain uncertain.
- The proposed recommendations should serve as a guide for the fitness and health care professional working with cancer survivors. More research is needed to fill remaining gaps in knowledge to better serve cancer survivors, as well as fitness and health care professionals, to improve clinical practice.
- Campbell KL, Winters-Stone KM, Wisniewski L, et al. Exercise Guidelines for Cancer Survivors: Consensus Statement from International Multidisciplinary Roundtable. *Med Sci Sports Exerc*. 2019;51(11):2375-2390. doi:10.1249/00000000000002116

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## Exercise and breast cancer

- Exercise is one of the most important things you can do to stay healthy after being diagnosed with breast cancer. Research has shown that women who exercise have an improved quality of life and have fewer side effects during and following treatment. Exercise has also enhanced overall health and wellness, improved mood, reduced fatigue, and increased stamina. Some research suggests that exercise may reduce the chances of breast cancer recurrence.
  - The beginning of treatment is not the time to begin a strenuous exercise program. You will likely have days you feel energetic, and other days you may be more fatigued.
    - If you have already been exercising, keep it up as you feel able, listening to your body and allowing rest when your body asks for it.
    - If you want to exercise now, consider starting gently with a walking program. Many patients feel a daily walk improves their emotional and physical well-being during treatment
- An exercise plan which fits your personality, lifestyle, and health and fitness goals is an important part of breast cancer survivorship. As you move from treatment and into survivorship, you will want to consider the benefits of each type and develop a fitness plan that works for you.
- Types of Exercise
  - Cardiovascular exercise, sometimes called "cardio," is the type of exercise which increases your heart rate, and may cause you to break a sweat. This type of workout is recommended 30 minutes, five times a week (or 150 minutes per week), and includes activities such as walking, running, rowing, bicycling, or swimming. This kind of exercise improves heart health and helps maintain a healthy weight. Many people also find it helpful in managing stress and maintaining a sense of well-being.
- <http://www.hopkinsmedicine.org/kimmel-cancer-center/cancers-we-treat/breast-cancer-program/treatment-and->



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## People with Diabetes Recommended Physical Activity Program

- Physical activity programs for those with type 2 diabetes without significant complications or limitations should include appropriate endurance and resistance exercise for developing and maintaining cardiorespiratory fitness, body composition, and muscular strength and endurance. Individuals with type 2 diabetes spend a minimum cumulative total of 1000 kcal/wk in aerobic activity.
- **Resistance training program should be effective in improving muscular strength and endurance as well as in improving body composition by increasing or maintaining fat-free weight. (ACSM)**

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## Psychological effects of exercise on diabetes

- Diabetes management is emotionally stressful,
  - this stress can influence glycemic control,
  - regular physical activity can play a role
- in reducing stress, enhancing psychological well-being, and quality of life for people with type 2 diabetes. (ACSM)

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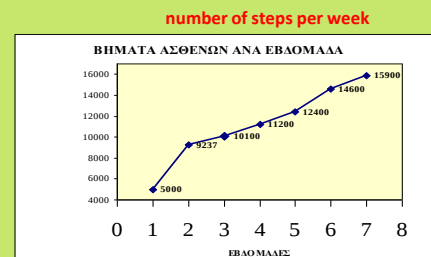
## Psychological Effects of Exercise in Cardiac Patients

Maria Mousouli, Yannis Theodorakis &amp; Alexandros Kritikos

- The findings of most studies establish the important role of physical activity in cardiac rehabilitation programs
- Exercise is beneficial for the improvement of patients' quality of life, mental health, well being, and particularly for the prevention of depression and anxiety.
- The contribution of physical activity is substantial in rehabilitation programs, as it reflected not only on physiological, but also on psychological indicators.

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**The effectiveness of a goal setting program in increasing walking by using pedometers. 21 patients (65 years of age)**  
The total number of steps were increased as well as Self efficacy and quality of life



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## Persons with schizophrenia

- A 16-week walking program for outpatients diagnosed with schizophrenia.
- Experimental participants in the walking group experienced **significant reductions in body fat, greater aerobic fitness,**
- **lower body mass indexes,**
- **and fewer psychiatric symptoms**
- than controls at the conclusion of the program.

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## Schizophrenia

Fogarty et al.

- A study was conducted with six patients diagnosed with schizophrenia who participated in a 3-month physical conditioning program.
- Most participants increased their physical strength and endurance and exhibited improvements in weight control and flexibility.
- **The majority of patients reported increased fitness levels, exercise tolerance, reduced blood pressure levels, perceived energy levels and upper body and hand grip strength levels.**

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## Psychological effects of exercise on Patients with Schizophrenia.

8 weeks duration of the exercise program

**Positive effects as felling more vigorous and with higher self-esteem, body image quality of life,**

- Leading to an improved personal care and less social limitations

• Kokland et al, 2013, Maggourita et al 2014

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## Exercises on health-related quality of life in women with chronic low back pain

- A total of 101 volunteer women with CLBP provided data with a 3-month follow-up. They were randomized to either a Pilates (n= 37), trunk strengthening exercise (n= 36) or a control group (n= 28), exercising for a period of 8 weeks, three times a week. Data were collected on HRQOL using the Short-Form 36 Health Survey (SF-36v2), and functional disability using the Roland Morris Disability Questionnaire prior to program initiation, mid-intervention, immediately after program termination, and three months post-intervention.
- The Pilates participants reported greater improvements on self-reported functional disability and HRQOL compared with participants in the trunk strengthening exercise and control groups ( $p < 0.05$ ). The effects were retained for a period of three months after program termination for the Pilates group and to a lesser extent for the trunk strengthening exercise group.
- **An 8-week Pilates program improved HRQOL and reduced functional disability more than either a trunk strengthening exercise program or controls among women with CLBP.**
- Kofotolis, N., Kellis, E., Vlachopoulos, S., Goutas, I., & Theodorakis, Y. (2016). Effects of Pilates and trunk strengthening exercises on health-related quality of life in women with chronic low back pain. *Journal of Back and Musculoskeletal Rehabilitation*

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## Back pain

- Exercise psychology could help construct a movement education programme for those suffering from back pain that increases patients **confidence that they can move in a pain-free way.**

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## Exercise dementia and Alzheimer

- An extensive amount of research on the benefits of exercise supports that exercise plays a vital role on health, physical functioning and quality of life, and in the prevention and rehabilitation of many diseases such as dementia. People suffering from dementia number 46.8 million worldwide, while 7.7 million new cases of dementia are recorded each year. In Greece, patients suffering from one of the categories of dementia, the Alzheimer disease, have been calculated to be around 200,000 and that they will reach 500,000 by 2050. Inactivity alone, constitutes the cause of 3.8% of all dementia cases worldwide.
- Recently, exercise has been recognized to benefit these patient populations both as a mechanism for the amelioration of their health and the prevention of dementia as well as a mechanism for the improvement of their cognitive functioning and memory

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## Exercise, dementia and Alzheimer

- Physical exercise is a useful method for improving the condition of dementia patients.
- Help older individuals with dementia to improve their health and well-being.
- Help relieve or delay declines in activities of daily living (ADL) functioning for dementia patients who have mild to moderate conditions.
- Help with cognitive improvement and overall functioning of the brain and its structures.
- Help improve balance, motor sequences, stride length and performance of activities of daily living, which are severely affected by Alzheimer's disease.

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## Alzheimer patients

Research shows that participation in physical activity is connected with the reduction of illness growth as well as the improvement of quality of life of Alzheimer patients (Mouzakidis et al.

2005; Deslandes et al., 2009).

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### Simultaneous Aerobic Exercise and Memory Training Program in Older Adults with Subjective Memory Impairments

#### Abstract.

**Background:** Several modifiable lifestyle factors have been shown to have potential beneficial effects in slowing cognitive decline. Two such factors that may affect cognitive performance and slow the progression of memory loss into dementia in older adults are cognitive training and physical activity. There are currently no effective treatments for dementia; therefore, preventative strategies to delay or prevent the onset of dementia are of critical importance.

**Objective:** The aim of this study was to determine the relative effectiveness of simultaneous performance of memory training and aerobic exercise to a sequential performance intervention on memory functioning in older adults.

**Methods:** 55 older adults (aged 60–75) with subjective memory impairments (non-demented and non-MCI) completed the intervention that consisted of 90-minute small group classes held twice weekly. Participants were randomized to either 4 weeks of supervised strategy-based memory training done simultaneously while stationary cycling (SIM) or sequentially after the stationary cycling (SEQ). Standardized neurocognitive measures of memory, executive functioning, speed of processing, attention, and cognitive flexibility were assessed at baseline and post-intervention.

**Results:** The SIM group, but not the SEQ group, had a significant improvement on composite memory following the intervention ( $t(51) = 2.7$ ,  $p = 0.01$ , effect size ( $ES$ ) = 0.42) and transfer to non-trained reasoning abilities ( $t(51) = 6.0$ ,  $ES = 0.49$ ) and complex attention ( $t(51) = 3.1$ ,  $p = 0.003$ ,  $ES = 0.70$ ). Conversely, the SEQ group, but not the SIM, showed significant improvement in executive functioning ( $t(51) = 5.0$ ,  $p = 0.0001$ ,  $ES = 0.96$ ).

**Conclusion:** These findings indicate that a 4-week simultaneous memory training and aerobic exercise program is sufficient to improve memory, attention, and reasoning abilities in older adults.

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## Relevant studies- exercise through Virtual reality environment

An innovative project: results.

Participants showed a significant preference for the VR condition as well as high acceptance scores for intended future use, attitude toward VR training, and enjoyment.

VRADA training system acts as a non-pharmacological dual intervention to alleviate symptoms of the pathophysiology of Mild Cognitive Impairment.

The inflammatory factors IL-1 $\beta$  and TNF- $\alpha$ .

A series of linear regression models revealed that the VRADA group showed improvement or no deterioration in cognitive decline in global cognitive function (MMSE), verbal memory (Rey Auditory Verbal Learning Test and WAIS forward test), and executive functions, mental flexibility (Trail Making Test B).

The VRADA system improves the cognitive function of elders with MCI.

Baldimiro E, Mouzakidis C, Karathanasi EM, Venykeou E, Hassandra M, Galani E, Hatzigeorgiadis A, Goudas M, Zikas P, Evangelou G, Papagiannakis G, Bellis G, Kokkoti C, Tsatalas T, Giakas G, Theodorakis Y, Tsolaki M. Effects of Virtual Reality Physical and Cognitive Training Intervention On Cognitive Abilities of Elders with Mild Cognitive Impairment. J Alzheimer Dis Rep. 2023 Dec 29;7(1):1475-1490. doi: 10.3233/JADN-230099. PMID: 38225966. PMCID: PMC10789285.

Tzarakis E, Tsolaki M, Andreadou E, G., Mouzakidis C, Baldimiro E, N., Karathanasi E, M., Hassandra M, Galani E, Hatzigeorgiadis A, Goudas M, Zikas P, Evangelou G, Papagiannakis G, Bellis G, Kokkoti C, Tsatalas T, Giakas G, Theodorakis Y, Tsolaki M., Pantazaki A. A. (2023). VRADA training system as a non-pharmacological dual intervention to alleviate symptoms of the pathophysiology of Mild Cognitive Impairment. Brain Disorders, 11, 100090. <https://doi.org/10.1016/j.dbsch.2023.100090>



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## Studies on Virtual reality

<https://drive.google.com/file/d/1s2sL7GyxqHvqAJMOpJwKrrQqubRsVQp/view>

<http://psych.pe.uth.gr/index.php/el/projects/vrada>

- Theodorakis, Y., Morres, I., Hassandra, M., Goudas, M., Tsolaki, M. & Mouzakidis, C. (Eds.) (2021). Recommendations on EU Guidelines for the use of Physical Activity on Mental Health. Interactive Living for Mental Health Project. ISBN 978-960-69923-5-1. DOI: 10.13140/RG.2.2.24494.55207
- Baldimtsi E, Mouzakidis C, Karathanasi EM, Vervikou E, Hassandra M, Galanis E, Hatzigeorgiadis A, Goudas M, Zikas P, Evangelou G, Papagiannakis G, Bellis G, Kokkoti C, Tsatalas T, Giakas G, Theodorakis Y, Tsolaki M. (2023). Effects of Virtual Reality Physical and Cognitive Training Intervention On Cognitive Abilities of Elders with Mild Cognitive Impairment. *J Alzheimers Dis Rep*. 2023 Dec 29;7(1):1475-1490. doi: 10.3233/ADR-230099. PMID: 38225966. PMCID: PMC10789285.
- Hassandra, M., Galanis, E., Hatzigeorgiadis, A., Goudas, M., Mouzakidis, M., Karathanasi, E., Perdikis, N., Tsolaki, M., Zikas, P., Evangelou, G., Papagiannakis, G., Bellis, G., Kokkoti, C., Panagiotopoulos, S., Giakas, G., Theodorakis, Y. (2023). A Virtual Reality App for Physical and Cognitive Training of Older People With Mild Cognitive Impairment: Mixed Methods Feasibility Study. *JMIR Serious Games*, 24(3):e24179. doi:10.2196/24179
- Stavrou, V.T., Vavougiou, G.D., Kalojiannis, P., Theodorakis, Y., Gourgoularis, K.I. (2023). Breathlessness and exercise with virtual reality system in long-post-coronavirus disease 2019 patients. *Frontiers in Public Health*, 2023, 11, 1115393.
- Toutoudis, E., Hassandra, M., Galanis, E., Goudas, M., Theodorakis, Y. (2022). Applicability of an Immersive Virtual Reality Exercise Training System for Office Workers during Working Hours. *Sports*, 10, 104 <https://doi.org/10.3390/sports1007104>.

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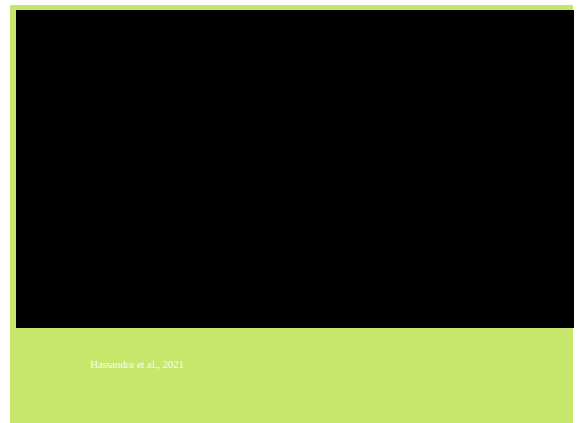
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Hassandra et al., 2021

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## Anxiety, stress and depression

- Exercise has a low-moderate anxiety-reducing effect
- Exercise training can reduce trait anxiety and single exercise sessions can reductions in state anxiety
- Single sessions of moderate exercise can reduce short-term physiological reactivity to, and enhance recovery from, brief psychosocial stressors (Taylor, 2000)
- WHO has predicted that depression will create the greatest burden of disease by 2020

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## Depressive Symptom Outcomes of Physical Activity Interventions: Meta-analysis Findings, (Conn, 2010)

- Supervised PA interventions may be more effective when they include flexibility/resistance and low-intensity exercise.
- Findings document that PA interventions reduce depressive symptoms even in adults without clinical depression.

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## Physical Activity and Symptoms of Major Depression in Middle Childhood 6-8 years of age

At both age 6 and 8 years, higher MVPA predicted fewer symptoms of major depressive disorders 2 years later. Sedentary behavior did not predict depression, and depression predicted neither MVPA nor sedentary activity. The number of symptoms of major depression declined from ages 6 to 8 years and evidenced modest continuity.

Moderate to Vigorous PA predicts fewer symptoms of major depression in middle childhood, and increasing MVPA may serve as a complementary method to prevent and treat childhood depression.

Zuhl, T., Steinbock, S., & Wichstrom, L. (2017). Physical Activity, Sedentary Behavior, and Symptoms of Major Depression in Middle Childhood. *Pediatrics*, 139(2), e20161711

43

## Exercise, anxiety & depression

Arent & Landers

- Meta-analytic evidence has generally demonstrated a robust effect for exercise, as reduction in anxiety and depression scores occur for all types of people (i.e., male and female, fit and unfit, active and inactive, clinically anxious and nonanxious, clinically depressed and normal, healthy and unhealthy, young and old). However, the magnitude of these effects varies as a function of certain subject characteristics.

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## Exercise anxiety & depression

Arent & Landers

- Although meta-analyses indicate that normal people significantly reduce anxiety and depression scores with exercise, clinical patients with moderate to severe Major Depression or anxiety disorders show even greater reductions. Additionally, patients who are very unfit (i.e., cardiac rehabilitation patients, psychiatric patients) often demonstrate even greater mental health benefits from exercise compared to people who are mentally and physically healthy.

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## Exercise and obesity

- The effectiveness of an exercise intervention including both aerobics and resistance training components in improving physical self-perceptions and global self-esteem (GSE) in women with obesity was examined. An experimental design with a one-year follow-up was used.
- Women with obesity (n = 72) participated in a structured exercise programme for 12 weeks after being randomised into a control and an exercise group. Exercise self-efficacy, body attractiveness, physical strength, sport competence, physical condition, physical self-worth, and GSE were measured at pre-intervention, early intervention, mid-intervention, immediately after the intervention, and five times following programme termination at 1, 3, 6, 9, and 12 months, respectively. Analyses of covariance revealed exercise effects for all of the dependent variables except for body attractiveness.
- Generally, exercise effects lasted between 6 and 12 months. A 12-week physical exercise programme including aerobic and resistance training components has the potential to improve physical self-perceptions and self-esteem in women with obesity.

Megakli, T., Vlachopoulos, S., Thegersen-Ntoumani, C., Theodorakis, Y. (2015). Impact of aerobic and resistance exercise combination on physical self-perceptions and self-esteem in women with obesity with one-year follow-up. *International Journal of Sport and Exercise Psychology*, 1-22.

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## Other diseases

- **multiple sclerosis**
- Exercise training improves depressive symptoms, and quality of life, mobility, weight control, balance, confidence, in people with multiple sclerosis
- Exercise programs 3 times per week, 45 min in the water
- **Stroke Survivors.**
- Physiotherapy
- Exercise, muscular endurance, low intensity aerobic exercise
- Quality of life, physical fitness, pain reduction (Billinger et al., 2014).
- **Parkinson.** Physiotherapy, and exercise programs, 60 to 75 min, three times per week
- Quality of life
- 
- **Chronic kidney disease.**
- Low intensity aerobic exercise in ergometer bicycle improves physical fitness, quality of life, and levels of depression. No specific exercise protocol yet.

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## Multiple sclerosis



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**Exercise training guidelines for multiple sclerosis:**

Exercise guidelines for MS consistently recommended 2-3 days/week of aerobic training (10-30 minutes at moderate intensity) and 2-3 days/week of resistance training (1-3 sets of 8-15 repetition maximum (RM)). ACSM recommends participation of 150 min of moderate cardiovascular exercise (40 – 60% heart rate reserve [HRR]) or 75 min of vigorous exercise (60 – 85% HRR) each week.

Taking into account comorbidities and symptom fluctuations, healthcare providers should encourage >150min/week of exercise and/or

**>150min/week of lifestyle physical activity****General, aerobic exercise prescription.**

The frequency ranges between 2 and 3 days per week and should generally start with 2 days per week and progress toward 3 days per week over time. The duration of the exercise bouts ranges between 10 and 30 minutes and should gradually progress from 10 to 30 minutes over time. The intensity should be moderate and range between 11 and 13 on the 20-point rating of perceived exertion (RPE) scale, or between 40 and 60% peak oxygen consumption ( $\dot{V}O_{2peak}$ ) or peak heart rate ( $HR_{peak}$ ). The modality of exercise is listed in [Table 1](#). The overall progression should start with increases in either duration or frequency. Progression in intensity should be based on the tolerability of the individual with MS, only after duration and frequency are well tolerated.

**Advanced, aerobic exercise prescription.**

The frequency can approach 5 days per week; the duration of the exercise bouts can approach 40 minutes; the intensity can approach a 15 on the 20-point RPE scale, 70%  $\dot{V}O_{2peak}$ , or 80%  $HR_{peak}$ . The modality can include the same as the general guidelines but may be extended into swimming and road cycling. The overall progression should start with increases in either duration or frequency, followed by increases in intensity as tolerated by the individual.

**General, resistance exercise prescription.**

The frequency ranges between 2 and 3 days per week and should generally start with 2 days per week and progress toward 3 days per week over time. The exercise bouts should range from 1 to 3 sets between 6 to 15 repetition maximum (RM) and consist of 5 to 10 exercises. Resistance training should mainly focus on major muscle groups, especially the lower extremities, and include these muscle groups that are the weakest and/or most functionally deficient. There should be adequate rest between exercise groups of between 2 and 4 minutes. The modality of exercise is provided in [Table 1](#). There should be a day of rest between resistance training sessions, but the sessions can be performed on the same day as aerobic exercise training, depending on tolerability.

**Special considerations.** An exercise prescription for people with MS should promote a safe and individualized exercise regimen. Thus, before prescribing an exercise routine, MS-specific symptoms/characteristics (e.g., fatigue and heat sensitivity) should be identified and discussed, and the exercise prescription should include appropriate modifications. For example, individuals with high heat sensitivity should exercise in a cool environment, and a cooling fan should be readily available for the person during the exercise session. When individuals experience symptom exacerbation, either daily variation in symptoms or relapse, the exercise program may require modification or be temporarily discontinued until the symptoms are stable. Risk of falling should be considered for individuals with MS, and individuals with high risk of falls should perform both aerobic and

## General results

• **Objective.** To quantify the dose-response associations between total physical activity and risk of breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke events.

• **Conclusions** People who achieve total physical activity levels several times higher than the current recommended minimum level have a significant reduction in the risk of the five diseases studied

• Kyu, H., Bachman, V., Alexander, L., Mumford, J., Estep, K., Veerman, L., Delwiche, K., Iannarone, M., Afshin, A., Moyer, M., Cenci, K., Vos, T., Murray, C., Forouzanfar, M. (2016). Physical activity and risk of breast cancer, colon cancer, diabetes, ischemic heart disease, and ischemic stroke events: systematic review and dose-response meta-analysis for the Global Burden of Disease Study 2013. *Lancet*. 2016;387(10057):1541-1551. [http://dx.doi.org/10.1016/S0140-6736\(16\)00444-1](http://dx.doi.org/10.1016/S0140-6736(16)00444-1)

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## Exercise and mental health

### Association between physical exercise and mental health in 1·2 million individuals in the USA between 2011 and 2015: a cross-sectional study

**Summary**

**Background** Exercise is known to be associated with reduced risk of all-cause mortality, cardiovascular disease, obesity, and diabetes, but its association with mental health remains unclear. We aimed to measure the association between exercise and mental health burden in a large sample, and to better understand the influence of exercise type (frequency, duration, and intensity).

**Methods** We conducted a cross-sectional study using data from the 2011-2015 National Health and Medical Research Council Australian Health Surveys. We included the number of days of total self-reported moderate-to-vigorous physical activity (MVPA) and days of total self-reported sedentary behavior (SED) in the past 7 days. We also included the number of days of total self-reported walking and cycling in the past 7 days. We used multivariable regression to estimate the association between exercise and mental health burden, adjusting for age, sex, education, income, and other factors. We also examined the association between exercise and mental health burden, adjusting for age, sex, education, income, and other factors. We also examined the association between exercise and mental health burden, adjusting for age, sex, education, income, and other factors.

**Findings** Individuals who exercised high (≥ 150 min/week) had lower levels of mental health burden than those who did not exercise. We observed a dose-response relationship between exercise and mental health burden, with higher levels of exercise associated with lower levels of mental health burden. The association between exercise and mental health burden was stronger for walking and cycling than for other types of exercise. The association between exercise and mental health burden was also stronger for individuals with higher levels of education and income.

**Conclusions** In this large US sample, physical exercise was significantly and consistently associated with reduced mental health burden. These associations were not observed for sedentary behavior or for walking and cycling. Our findings suggest that physical exercise may be a useful strategy to reduce mental health burden, and that the benefits of exercise may be greater for individuals with higher levels of education and income.

**Introduction** Exercise is known to be associated with reduced risk of all-cause mortality, cardiovascular disease, obesity, and diabetes, but its association with mental health remains unclear. We aimed to measure the association between exercise and mental health burden in a large sample, and to better understand the influence of exercise type (frequency, duration, and intensity).

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Exercise has beneficial effects on health for many **clinical populations: cancer, cardiac patients, depression, schizophrenia, diabetes, HIV, Alzheimer, etc.**

• Exercise can be used in Behavior change strategies and interventions

• **Type of exercise:**

• **Low to moderate intensity, aerobic exercise, resistance training**

• **Psychological effects:**

• **mental health, quality of life, self esteem, body image, positive mood and affect, self confidence, enhancing psychological well-being, and lower levels of depression, anxiety, tension, fatigue, anger** (Courneya, Steinsson, & Vallance, 2007).

## • The explanation of the psychological and physiologic mechanisms

## Some general results

(ACSM, 2011).

• According to the sport science literature and research evidence,

• the application of psychological and physiological principles of exercise to clinical populations is of great importance **since quality of life** is a significant outcome derived from long-term adherence to exercise.

• **All-cause mortality is delayed by regular engagement in physical activity**

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## Psychological effects of exercise

- As people exercise and their sense of mastery and confidence in exercising and dealing with their environment increases, they may become less depressed and anxious.
- Exercise increase self esteem, body image and self-concept, particularly for physical attributes, thus influencing depressive or anxious symptomatology.
- Social interaction and social support have also been mentioned as possible explanations.

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## Pleasure and satisfaction

- The psychological and physiological benefits of exercise are realized when the patient perceives frequently **the pleasure and satisfaction derived from his attendance to the exercise programs.**
- The individual **perceives that he is able to perform daily activities** that he couldn't do previously due to restrictions imposed by illness, such as go for shopping, or move in the city and the countryside, walk in a park, and participate in social events.
- The patient is more easily integrated **in the society, returns in his work and believes in general that he is able to live more 'normally'.**
- **Exercise is now recognized as a low cost factor of prevention or treatment of many illnesses.**

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## Physiological Explanations for the Anxiolytic and Antidepressant Effects of Exercise

- contributing in this positive outcome **is not yet clarified.**
- The activation of the mechanisms of **endorphin secretion and body temperature fluctuation or via changing of neurotransmitters** (Landers & Arent, 2007).
- the **endorphin hypothesis,**
- the **endocannabinoid hypothesis,**
- the **serotonin (5-HT) hypothesis,**
- the **norepinephrine (NE) hypothesis, and the hypothalamic-pituitary-adrenal (HPA) axis hypothesis.**

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## In general, patients in almost all kinds of disease and disability could benefit from exercise.

- The majority of them choose not to exercise.
- Lack of motivation toward exercise constitutes a significant drawback for clinical populations.
- Cognitive-behavioral approaches have been developed and adopted to help people, especially those who are initially very inactive, build regular physical activity patterns. These approaches using principles of behavior change derived from cognitive behavioral therapy and health counseling.
- Models and theories named attitudinal/belief, self perception, self-determination, self-efficacy, and social support are used in the process of helping people change their behaviors (O'Donovan et al., 2010).

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## Exercise for clinical population. Hypotheses & mechanisms

- Exercise programs & physical activities **may increase individuals' confidence** to overcome the difficulties, and might lead to **reductions in stress, depression, irritability, restlessness etc.**
- Following exercise participation people may have an increased capacity **to manage stress, depression, anger and fatigue, as well as increased vigor.**

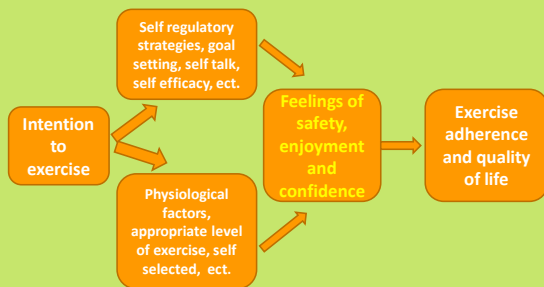
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## Exercise clinical populations Hypotheses & mechanisms

- **Many forms of exercise and physical activity are associated with increased psychological well-being, strength and vitality, and a sense of 'feeling better'.**
- This feeling is attested to be strong after an exercise program, where people **feel pleasant mood changes.**
- Regular physical activity increases caloric expenditure, and may **increase the metabolic rate and reduce the weight gain**

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## From exercise to quality of life



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## Recommendations Exercise, anxiety & depression

Arent &amp; Landers

- There is now evidence to indicate that both aerobic (e.g., running, swimming, cycling) and anaerobic (e.g., resistance training) exercise reduces anxiety and depression scores, and increasing positive mood.

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## Snacktivity

- Background: A novel „whole day“ approach that could motivate the public to be more physically active is termed Snacktivity™. Consistent with guidance, the Snacktivity™ approach encourages the public to accumulate ≥150 minutes of physical activity in short 2–5-minute „activity snacks“ of moderate-vigorous intensity physical activity throughout the day/week. Snacktivity™ also promotes muscle-strengthening activity twice per week. Following completion of research to co-design and develop the Snacktivity™ approach, the aim of this trial is to assess the effectiveness and cost-effectiveness of a Snacktivity™ intervention to increase physical activity and reduce future risk of disease in the population, compared with usual care. care comparator group.
- The Snacktivity intervention involves two main components; a brief 5-minute consultation about the principles and purpose of Snacktivity™; and access to technology support (mobile phone app called the SnackApp, linked to a Fitbit activity device (Versa 4)) that through behavioural change techniques promote self-monitoring of physical activity, habit formation, action planning and feedback on the number of activity snacks completed each day. The primary outcome is the difference in average minutes of moderate-vigorous physical activity between the groups at 12-months follow up, measured using a wrist worn accelerometer. Secondary outcomes include accelerometer-assessed average minutes per day of light, moderate, and vigorous intensity physical activity, time sedentary, weight and psychological health outcomes, at 12 month follow-up.
- Discussion: Innovative interventions such as Snacktivity™, that aim to support the public to increase their physical activity each day are required. Findings could inform future public health guidance and public health messaging that seeks to raise awareness in the population of the potential benefits of Snacktivity™ for health.

© 2024, A. Smith & Partners Ltd. All rights reserved. The effectiveness and cost-effectiveness of Snacktivity™ as an intervention to promote physical activity and health outcomes: a study protocol for a multi-centre randomised controlled trial. Trials 2024, 25(1):1-12. https://doi.org/10.1186/s13063-024-06888-8

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## Recommendations.

### Exercise for breast cancer survivors

- **Type of exercise:** Aerobic exercise (55–70% max, 3-5 times per week, 20-30 min), resistance training.
- **Walking**
- **Psychological effects:** Quality of life, self esteem, self confidence, and lower levels of depression and anxiety (Courneya, Steinsson, & Vallance, 2007).

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## The effects of resistance training on quality of life Cramp, et al.

- **a resistance training program,**
- It is possible to increase muscle strength in cancer survivors
- Marginal improvements in QoL are also apparent immediately following a resistance training program.

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## Recommendation HIV

- Aerobic exercise programs 6 to 12 weeks.
- Positive effects on mood, quality of life
- and reduction on stress and depression
- (Stringer, 2005).
- Studies have observed a decrease in the rate of depressive symptoms and improved QoL/psychological well-being in HIV
- Aerobic exercise appears to provide greater improvements in psychological well-being when compared to resistance exercises in some studies..

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## Recommendations

### Examples of incremental goals

- **GOALS SET IN MINUTES**
- **Week 1 Aim:** To accumulate an extra **15 minutes** of walking on **at least 3 days** of the week.
- **Weeks 2 and 3** add days and minutes incrementally
- **Week 4 Aim:** To add from baseline an accumulated **30 minutes of walking** on most days of the week
- **GOALS SET IN STEP COUNTS**
- **Week 1 Aim:** To increase baseline step count by **1500 steps** on **at least 3 days** of the week.
- **Weeks 2 and 3** add days and steps incrementally
- **Week 4 Aim:** To increase by **3,000 steps per day** from baseline most days of week

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## Recommendations

### Goal setting form for exercise

| Τι δραστηριότητα επιλέγεις | Ποιος είναι ο στόχος σου | Στόχος δέκατη τρίτη μέρα | Γράψε τι έκανες τη δέκατη τρίτη μέρα | Στόχος δέκατη τέταρτη μέρα | Γράψε τι έκανες τη δέκατη τέταρτη |
|----------------------------|--------------------------|--------------------------|--------------------------------------|----------------------------|-----------------------------------|
| Περπάτημα                  | χιλιόμετρα               |                          |                                      |                            |                                   |
|                            | ή χρόνος                 |                          |                                      |                            |                                   |
| Τρέξιμο                    | Χιλιόμετρα               |                          |                                      |                            |                                   |
|                            | ή χρόνος                 |                          |                                      |                            |                                   |
| Άσκηση σε γυμναστήριο      | χρόνος                   |                          |                                      |                            |                                   |
| Ομαδικό άθλημα             | χρόνος ή ένταση          |                          |                                      |                            |                                   |
| Κάτι άλλο                  |                          |                          |                                      |                            |                                   |

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## Recommendations for practice

- Promoting physical activity in the community should involve unsupervised activity opportunities as well as supervised classes
- **Walking offers the simplest and most accessible mode of physical activity for the majority of the sedentary population**
- **All promotion should include cognitive behavioural principles of behaviour change**
- Primary care teams should consider training of staff in physical activity promotion.

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## Practical implication

- **GPS and Pedometers are cheap and accurate tools for measuring step counts but can they motivate people to walk more**

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## Recommendations

### exercise & depression

- **Low to moderate intensity aerobic exercise 45 to 60 min, 3 times per week**
- **Or 30 min of Low to moderate intensity, aerobic exercise, and/or resistance training, 5 times per week**
- **Try to increase from 150 to 300 min per week**
- **Walking**
- **Relaxation technique**

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Effect of exercise for depression: systematic review and network meta-analysis of randomised controlled trials  
Noetel et al., (2024). BMJ 2024;384:e075847  
<http://dx.doi.org/10.1136/bmj-2023-075847>

- Many exercise modalities appear to be effective treatments, particularly walking or jogging, strength training, and yoga, but confidence in many of the findings was low. (eg, yoga for older men, strength training for younger women).
- Many patients may have physical, psychological, or social barriers to participation. Still, some interventions with few costs, side effects, or pragmatic barriers, such as walking and jogging, are effective across people with different personal characteristics, severity of depression, and comorbidities. Those who are able may want to choose more intense exercise in a structured environment to further decrease depression symptoms.

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### Is running associated with a lower risk of all-cause, cardiovascular and cancer mortality, and is the more the better? A systematic review and meta-analysis

- Objective To investigate the association of running participation and the dose of running with the risk of all-cause, cardiovascular and cancer mortality.
- Systematic review and meta-analysis
- In total, 25 951 deaths were recorded during 5.5–35 year follow-ups.
- **Running participation is associated with 27%, 30% and 23% lower risk of all-cause, cardiovascular and cancer mortality, respectively, compared with no running.**
- Conclusion: Increased rates of participation in running, regardless of its dose, would probably lead to substantial improvements in population health and longevity. Any amount of running, even just once a week, is better than no running, but higher doses of running may not necessarily be associated with greater mortality benefits.

• To cite: Pedisic Z, Shrestha N, Kovalchik S, et al. Br J Sports Med Epub ahead of print: [please include Day Month Year]. doi:10.1136/bjsports-2018-100493

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### General results

- It is important to apply **principles of exercise psychology to clinical populations** because quality of life is an important outcome from exercise and long-term adherence is beneficial to these patient groups.
- The long-term goal for exercise specialists working with patient populations is to assist them in becoming **independent exercisers**

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### General results

- **Clinical populations have the need of systematic psychological support from specialized personnel, so as to remain long-term active in exercise programs**
- Especially for these patients **obstacles toward exercise** are very intense, due to their particular physical and psychological problems often deal with, such as weakness, permanent fear, and low self-confidence that they are in position to successfully correspond in physical activity programs.

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### General results

- Maintaining regular activity after supervised hospital-based programmes is difficult for cardiac rehabilitation patients and requires urgent attention from exercise psychology research.

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### Effects of physical activity on psychological well-being. Front. Psychol

- Physical activity significantly contributes to both a healthier life expectancy and an improved quality of life and positively influences cognitive function across diverse populations
- The benefits of physical activity: psychological advantages, life satisfaction, positive emotions, self-esteem, self-efficacy, self-confidence, and improved physical competence. Particularly in children, regular physical activity fosters the development of socio-emotional skills.
- Furthermore, higher levels of physical activity correlate with reduced cortisol levels, diminished negative moods, decreased symptoms of depression and anxiety, and fewer sleep disturbances.
- Physical activity can be regarded as a protective factor against elevated stress levels, negative attitudes towards stress, depression, unhealthy dietary patterns, and sedentary behavior.
- The positive effects associated with physical activity. These include personality traits such as extraversion and openness, parental engagement in physical activity, moderate-intensity exercise, and the quality of physical education. Importantly, it is not solely the act of participating in sports or physical activities that yields these benefits, but also how such activities are structured and organized.
- Trajković N, Milić PM, Barić R and Bogataj Š (2023) Editorial: Effects of physical activity on psychological well-being. Front. Psychol. 14:1121976. doi: 10.3389/fpsyg.2023.1121976

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### Recommendations for next studies in the area

- Qualitative research
- Both researchers and practitioners should operate with a model of behaviour change to guide them.
- Activity must be recorded before and after any exercise programme or intervention.
- Investigate motivations and barriers to exercise in each patient group as a whole and also for those who have taken up the offer or completed an exercise programme.

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## Recommendations for next studies in the area

- **Personal focus**
- **Self regulatory strategies (goal, self talk, imagery, self-efficacy, or attentional focus) for both exercise adherence and stress reduction for clinical population**

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## Research questions

- Evidence suggests that problem drinkers can benefit from exercise programmes in terms of physical outcomes.
- However, evidence for mental health benefits or any advantage to reducing alcohol intake is weaker.
- Higher levels of physical activity are consistently related to lower levels of depression in population surveys.
- The question remains about which comes first.

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## A relaxation technique

- Choose to breath in and out slowly whenever you need to relax or before you perform
- Choose to let go of any unnecessary stress, doubts, or worries. Let them flow away like water flowing gently down a stream.

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## Topics for discussion

- Reasons for universities or other bodies/ to promote exercise programs for health and quality of life, in clinical and non clinical population.
- General recommendation for educational, sport and governmental bodies

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## Review questions

- Relationships between exercise and health
- Reasons for non clinical population to exercise
- Reasons for clinical population to increase exercise
- Strategies for clinical population to increase exercise
- Recommended types and forms of exercise for healthy and clinical populations

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## Interventions targeting sitting in the workplace

- In 2018, an updated systematic review was published, summarising the effectiveness of workplace interventions for reducing sitting time at work.<sup>48</sup> The interventions included physical workplace changes, such as providing height-adjustable desks to enable sitting or standing at work, pedalling workstations and treadmill desks, policy changes, information provision, counselling and computer prompts. Providing height-adjustable desks was the most frequently implemented intervention and was reported as the most promising for reducing sitting time at work, leading to reductions of 100 minutes per workday in the short term (up to 3 months) and 57 minutes per workday in the medium term (3–12 months). Although positive findings were observed, the quality of the evidence was deemed to be very low to low because of a lack of non-biased cluster randomised controlled trials (RCTs), small sample sizes (the majority had 20–50 participants) and a lack of longer-term follow-up. The review by Shrestha et al.<sup>48</sup> highlighted the need for larger cluster RCTs with long-term follow-up.
- Shrestha N, Kukkonen-Harjula KT, Verbeek JH, Ijaz S, Hermans V, Pedisic Z.

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- <https://www.youtube.com/watch?v=3v4n5CJZMvc>
- <http://ergoworksltd.com/product/deskrite-100-sit-stand-workstation-black/>

85

## A sample of studies in the area

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