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DISCOVERY SCIENTIFIC SOCIETY

The role of physical activity in sanatorium-based rehabilitation and its impact on health in older adults

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ABSTRACT

The global demographic shift towards population ageing has made something crystal clear. We need better ways to help older adults live independently and with a decent quality of life. Sanatorium based rehabilitation can be good solution because it combines medical care with regular physical activity what makes approach to health holistic. This review takes a closer look at the different types of physical activity used in sanatorium and it affects the physical, mental, and social health of people above 60 years old. It focuses on how different exercise programs can help prevent and manage things like sarcopenia, osteoarthritis, multimorbidity and functional decline. Physical activity is the key to improving musculoskeletal strength, cardiovascular efficiency, metabolic regulation, mental well-being and social engagement. Sanatorium based exercise programs are pretty important tool for encouraging to healthy lifestyle what can reduce the risk of disability for older people.

Keywords: physical activity, sanatorium rehabilitation, older adults, healthy ageing

1. INTRODUCTION

Population ageing is one of the biggest health and socio-economic challenges of the 21st century. The number of people more than 60 years old is expected to double by 2050 (World Health Organization, 2022). This shift in demographics brings an increased risk of chronic diseases, multimorbidity, frailty, and functional decline. Ageing is all about your body steadily running out of steam, including reduced muscle mass, decreased bone density, impaired balance and diminished cardiovascular capacity. All of these disabilities lead to issues like sarcopenia, osteoarthritis, osteoporosis, and a growing risk of falls. Disability also affects mental health, it can cause depression, social isolation and decreased self-efficacy which can reduce the quality of life. Population aging, we see also to go along with an increase in the number of chronic diseases, which in turn also causes health care costs to rise and the demand for long term health care services to go up. Also, as per global reports physical inactivity is a leading cause of death which at the same time puts to bear greatly on non communicable diseases. Also, it has been proven that

regular physical activity can do a great deal to reduce the risk of heart disease, type 2 diabetes, some cancers, and cognitive decline.

Also, it is of great importance that we maintain physical function, which in senior citizens means preservation of independence. We see that which structured exercise programs improve balance, strength and mobility which in turn greatly reduces the risk of falls and disability (Sherrington et al., 2020). Also, physical activity plays a key role in maintenance of cognitive function and in delaying the onset of dementia (Di Lorito et al., 2021).

Sanatorium based rehabilitation which is a unique model of care that brings together these elements in a controlled setting we see also which in that they promote physical activity through the use of supervision, routine and social engagement. A sanatorium based approach offers structured environment by combining medical supervision with physiotherapy, balneotherapy and organized physical activity programs. Unlike hospitals, sanatorium care is all about long term health restoration and helping people live independently.

Aim of the study

The main aim of our research is to compare different types of physical activity used in sanatorium-based rehabilitation programs and check how they affect the physical, mental, and social health of older adults. We were wondering what was more important in preventing sarcopenia and functional decline: resistance training, aquatic therapy or group based exercise. And on top of this, we wanted to understand the importance of tailoring exercise programs to the needs of individuals with multiple health conditions.

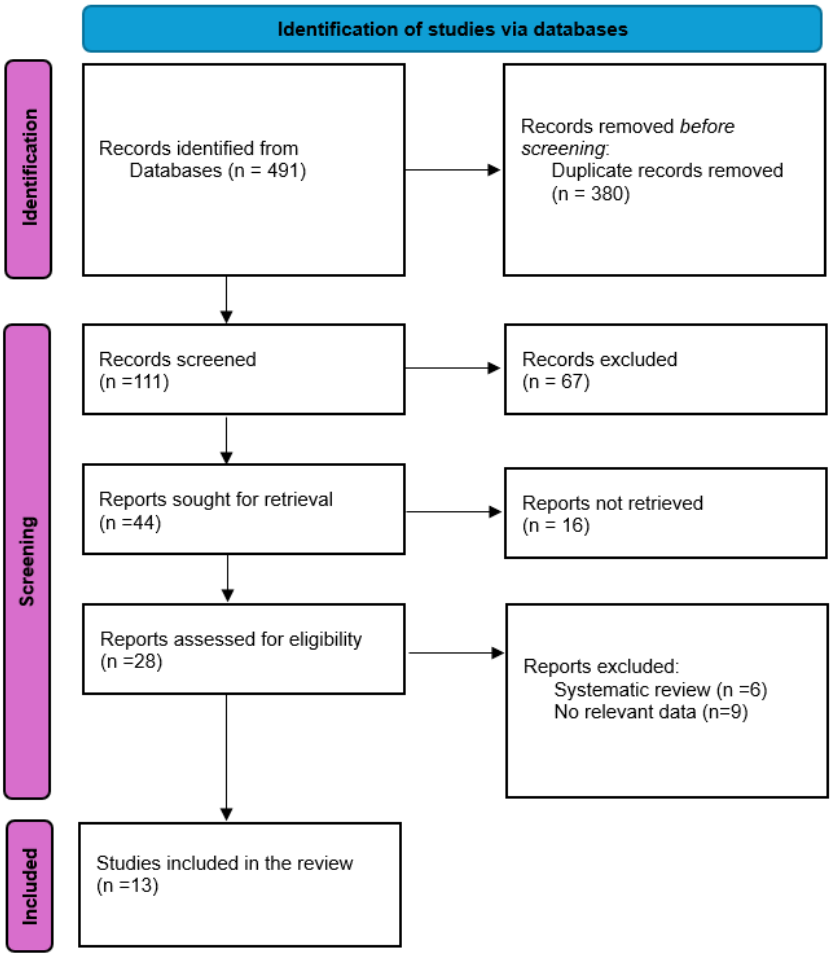

Figure 1. PRISMA flow diagram of study selection process

2. REVIEW METHODS

This narrative literature review brings together all the available evidence on physical activity interventions for older adults, especially in structured rehabilitation settings like sanatoriums. We searched various databases for relevant research. The international guidelines

from the World Health Organization, and the American College of Sports Medicine was provided to make sure our review is up to date. We looked at studies published recently but also we found earlier studies to expand our understanding of this topic.

To be included in our review, a study had to:

- feature participants aged 60, or over
- look at structured physical activity interventions
- report on measurable physical, psychological, or social outcomes
- be published in an English-language peer-reviewed journal

We excluded studies that focused only on younger populations or elite athletes, or that lacked in scientific methodology. We used thematic synthesis to categorize the outcomes of musculoskeletal, cardiovascular, metabolic, psychological, and social health in older adults. Particular attention was paid to supervised exercise models resembling sanatorium-based programs. A PRISMA flow diagram was used to present the study selection process (Figure 1).

3. RESULTS & DISCUSSION

3.1. Characteristics of Exercises

Sanatorium rehabilitation for older adults has got to be comprehensive and broad-based. (American College of Sports, 2021) That means exercise programs need to cover endurance, resistance and balance training, functional and flexibility exercises, and aquatic therapy. In a spa setting, patient do everything in a supervised environment and the exercises are tailored to the individual person's health condition. (Piercy et al., 2018).

3.1.1. Aerobic Training

Aerobic training forms the foundation of your rehabilitation programs – it is the core. In a spa setting, you might see it done as therapeutic walking, outdoor walking, Nordic walking, cycling on a stationary bike, or just some good old- fashioned general exercise classes. The key thing is to get the intensity right, for most people it should oscillate between 40 and 70% of their maximum heart rate. The exercise session should last 20 to 45 minutes (Bull et al., 2020). And you need to be doing this at least three times a week to get any real benefit. It is especially important for people with heart problems, high blood pressure, being overweight, and type 2 diabetes.

3.1.2. Resistance Training

The second important part of spa rehabilitation is resistance training which is all about keeping muscles strong (Borde et al., 2015). You do this in a spa setting using your own body weight, elastic bands, light dumbbells, balls, and even resistance machines. To train legs and lower back you can do squats, heel raises, sitting up from a chair and so on. Then there is the upper body, elbow bends, shoulder exercises, and so forth. To make this exercise effective you should do 8-15 repetitions per set, 3 sets at a time for each muscle group.

3.1.3. Aquatic Exercise

Aquatic exercise such as hydrokinesiotherapy is another key of sanatorium rehabilitation, especially when it comes to people who cannot do certain activities on land. In a pool, you can do all sorts of exercise to build up your strength, balance and general fitness activity. Water reduces the strain on your joints, which is why it is so good for people with arthritis, overweight or with back problems (Gomes-Neto et al., 2017). What is more, aquatic exercises are sometimes combined with relaxation elements to help cut down on muscle tension.

3.1.4. Balance and coordination training

Balance and coordination training is another important part of a spa-based program. You can strengthen this part of your body doing exercise such as standing on unstable surfaces, obstacle negotiation and line walking. To intensify the effect you can perform exercise with closed eyes (Sherrington et al., 2020). Functional training focuses on movements that replicate activities of daily living, such as rising from a seated position, stair climbing, and lifting objects from the floor.

3.1.5. Stretching and respiratory exercises

Flexibility and stretching exercises are an important part of rehabilitation. They help keep joints mobile and reduce muscle stiffness. For older adults, breathing exercises also play a key role, especially those that focus on using the diaphragm and improving breathing

rhythm. More and more often, programs also include elements of tai chi and therapeutic yoga, which combine gentle movement with focus and controlled breathing.

3.2. Health effects, and physiological mechanisms of physical activity

3.2.1. Effects on the cardiovascular system

Regular physical activity is a staple in spa settings, where physiological adaptations meet the cardiovascular, musculoskeletal, nervous, and immune systems (Pedersen & Saltin, 2015). It comes from a combination of getting the heart rate up and some pretty complex chemistry. In the heart, for example, aerobic exercise leads to an increase in cardiac output, a great improvement in how the blood vessels are working, and a boost in nitric oxide - the superheroes of the circulatory system. It means lower blood pressure and better blood supply to the muscles. On a cellular level, we start to see the real magic, the PGC-1α pathway starts firing away. Muscles are improving cells' ability to use oxygen and make exercise easier to handle.

3.2.2. Counteracting sarcopenia and neuroplasticity

Resistance training gets the mTOR signaling pathway pumping, which in turn gets the muscles to build themselves up and increases our overall power and strength. That fact makes daily life a whole lot easier to manage. Strength training also has a pretty neat side effect, it boosts brain-derived neurotrophic factor (BDNF) levels. BDNF is a protein important in terms of neuroplasticity (Di Lorito et al., 2021). Balance and functional exercises stimulate the cerebellum and motor cortex to get better at working together. This stimulation does not just make you more coordinated, it also reduces the risk of having a tumble and breaking something. Also respiratory exercises, such as deep breathing can actually reduce stress and help get a better night's sleep, mainly by getting the vagus nerve working overtime.

3.2.3. Anti-inflammatory effects

Regular physical activity also plays a big role in regulating the immune system. A good dose of exercise can reduce pro-inflammatory cytokines such as tumor necrosis factor alpha (TNF-α) and it can modulate the activity of interleukin-6 (IL-6). During exercise IL-^ acts as a myokine with anti-inflammatory properties and level out some inflammation that comes with getting older (inflammaging) (Pedersen & Saltin, 2015).

3.2.4. Impact on mental health

Nowadays the psychosocial benefits of regular physical activity are pretty well- documented. Regular training improves mood thanks to some pretty complex chemistry. It gets the cortisol levels down, which is a big deal cause high level of the cortisol is connected to stress and anxiety (Stubbs et al., 2018). In some cases, exercise was found to be as effective as some of the medications used to deal with depression. It can improve emotional regulation and reduce anxiety. Moreover, group fitness classes are a great way to integrate people into a community, which is a real game changer for preventing late- life depression.

3.3. Comparison of group and individual training

In sanatorium rehab settings, there are two main models for therapeutic exercise: individual training and group training. You have to choose the best model for you basing on a bunch of things: your medical status, how well you can function and what your goals are.

Individual training is pretty much what it sounds like: a physiotherapist will whip up a custom plan that you can do on your own. It is extremely useful for people with heart problems, neurological disorders or other things that might make it hard to do exercise on your own. That is because physio sees exactly what you can handle and make adjustments on the fly. It is also a great way to make sure you have got proper form and to keep an eye on your heart rate and blood pressure. The science is pretty clear, individually tailored rehab program has major impact on improving strength, flexibility and function especially in the first few weeks of treatment.

Group Training, as opposed to individualized training, is conducted in larger groups of patients. Quite often these groups engage in general conditioning exercises, aerobic exercises, balance training, or aquatic sessions, which is not tailored to the needs of each individual. However, group training tends to yield similar results in terms of improvements in aerobic capacity and overall physical fitness (Liu and Latham, 2009). Another significant advantage of group-based interventions is their positive psychosocial impact. It encourages interpersonal connections, reduces feelings of loneliness, promotes motivation by means of social support and also encourages positive health behavior through modelling. According to the World Health Organization recommendations, maintaining

physical activity should include both physical and social elements, something that the group-based model does rather well. On the other hand, the American College of Sports Medicine guidelines highlight the necessity of individualizing the intensity of the exercise to suit the patient and the specific nature of their condition.

From a practical perspective, group training is a good way to lower costs, and allow more patients to access rehabilitation services. Individual training is associated with higher costs but it is necessary for patients with higher level of medical risk. In fact, in the context of sanatorium-based rehabilitation, the most effective approach seems to be a hybrid model that combines initial one-to-ones and regular group sessions. This mix ensures high level of safety, effectiveness, and a positive impact on the patients mental health. All of them contribute to longer-term adherence to physical activity following completion of the treatment program.

3.4. The importance of balancing effectiveness and safety

Although exercise is well-proven to bring many benefits, it is also a medical intervention that requires proper medical training and supervision. There are absolute and relative contraindications to exercise. In those cases it is important to use a reduced intensity program, along with strict monitoring of heart rate, blood pressure, oxygen saturation and including the patient feelings. In the elderly population people can be more frailty, which increases the risk of injury or overexertion (Dent et al., 2019). Therefore, eligibility for a rehabilitation program should include a comprehensive assessment of the overall health, mental state, risk of falling and nutritional status. It is also crucial to remember that patients should not train too much. Exercise overload can actually aggravate the pain, increase inflammation and reduce peoples motivation. So, a principle of gradual progression and adjusting the training load to suit the individual is recommended. In designing an optimal spa rehabilitation program, you want to strike a balance between effectiveness and safety. You can provide it by doing initial medical checks, monitoring exercise parameters and educating the patient on what to look out for such as signs of resting heart failure, chest pain or dizziness. Maintaining peoples motivation and ensuring their safety requires an integrated approach that deals with medical, educational or psychosocial factors. In reality it should be done by introducing a model of ongoing support to help people maintain healthy behavior over the long-term.

3.5. Adherence after sanatorium rehabilitation

One of the major headaches of sanatorium-based rehabilitation is figuring out how to keep the health benefits going long after the patient has finished his stay. Compliance with physical activity recommendations depends on how well the patient sticks to the exercise plan he has. That is especially important when we are talking about people with chronic illnesses and an aging population. Research shows that although patients are enthusiastic about their exercise routine in sanatorium, things tend to fall apart within 3 to 6 months of going back home (Reiner et al., 2013). This phenomenon where the health benefits just kind of fade away is often called the "intervention decay effect". A bunch of things can contribute to poor adherence, such as lack of structure, limited access to the facilities, co-existing health problems, flagging motivation, and not having enough family support.

When you are looking at health psychology, key factors that can help someone stick with an exercise routine include having intrinsic motivation, believing in their ability to exercise, and actually wanting to take care of their health. Behavioral models, like self-determination theory, show that the only way to make real, lasting changes to your lifestyle is to see exercise as a core part of who you are, and not just something you have to do. In the context of spas, the key thing is getting patients to understand the importance of continuing their exercise routine at home. And this means giving them the tools and support they need to keep going. So, what can help people stick with exercise over the long haul? Well, you might find the following helpful:

- Having an exercise program tailored to the individual and allowing to do exercise at home
- Teaching people how to keep track of how hard they are working out, for example, using a scale to rate how hard things feel
- Having support from loved ones and the wider community
- Going to group exercise classes in the local community
- Using things like video consultations and activity tracking tools to stay on top of things

From a public health perspective, non-compliance with physical activity recommendations after leaving the sanatorium is a major problem. It means people are more likely to have to go back to the hospital, chronic diseases get worse more quickly, and it all ends up costing the healthcare system a lot more in the long run.

What the research says is clear: people need a lot of different kinds of exercise to make real progress. The World Health Organization, and the American College of Sports Medicine both recommend that exercise programs for older adults should include a mix of aerobic exercise, strength training, balance exercises and things that help them keep on doing the things they need to. Researches

shows that putting all these different types of exercise together is way more effective than just doing one type of exercise on its own. Aerobic exercise is crucial when it comes to preventing and treating heart disease, and getting fitter. Regular exercise can really lower blood pressure, improve cholesterol levels, and reduce the risk of heart problems. But even of positive impact for your heart, regular exercise on its own is not enough to prevent losing muscle strength as you age. That is why resistance training is so important.

As people get older, they begin to lose muscle mass, and that is when things get really serious. But studies show that if you do strength training regularly, you can actually increase muscle strength by up to 30-40% within 3 months (Borde et al., 2015). And what is really interesting is that it is not just about building muscle, it is also about being able to move around safely, which is especially important as we get older. The body of literature reinforces the importance of incorporating balance training into any sort of exercise regimen. Targeted exercises focused on proprioception reduce the risk of falls by roughly 23 to 30 percent (Sherrington et al., 2020). Falls are one of the number one causes of hospitalization and loss of independence in older adults. So, the idea to combine balance training with other sorts of exercise like resistance and aerobic training begins to look like a pretty solid clinical justification. Aquatic therapy has shown itself to be particularly useful for people with osteoarthritis or chronic pain issues. By reducing the impact on the joints, it is possible to get some kind of therapeutic intervention even in people who are pretty far gone with the degenerative changes. Meanwhile, it brings positive impact on strengthening. Of course, the gains in muscle strength may be not enough, comparing to doing the same kind of exercise on land. However, what is the most important, hydrotherapy can have a pretty big impact on overall quality of life and it can reduce a pain for those who use it.

Something else that is really important is to say that training that focuses on assisting people with the kinds of tasks they encounter daily is connected to increased independence. And what we see in the research is that improved performance in functional assessments such as the Timed Up and Go Test or the 30-Second Chair Stand Test is directly correlated with a lower risk of sudden accidents. Another really relevant point we need to bring up is the impact that physical activity can have on mental health.

Systematic reviews have shown us that regular exercise can really help reduce symptoms of depression and anxiety in older adults. It works in a few different mechanisms, not just the obvious ones like improving neurotransmitters such as serotonin and dopamine, but also increasing levels of BDNF, which supports neuroplasticity in the brain. In fact, for older adults in sanatorium, the social benefits of group-based activities end up being pretty valuable too, providing a way for people to connect and combat social isolation that can be such a big problem. When we are comparing the effectiveness of different exercise methods, we can see that combining them is bringing the best effects. Studies have shown that multicomponent programs not only make people stronger and more agile but also improve their cognitive function. And all of these lines up pretty well with this idea we have been hearing a lot about that 'exercise should be treated as medicine' with the added bonus that research has shown it really, really works. Of course, we have to acknowledge that a lot of used studies have one pretty significant limitation, namely, the fact that the populations, and exercise regimens were pretty varied. Which makes direct comparisons tricky. However, what we see time and time again is that the functional improvements are real and the risk of falls really does go down. And so, we can be pretty confident that our conclusions hold up. In the end, the science tells us that incorporating a mix of aerobic, resistance, balance training and functional training into sanatorium rehab is an effective and safe strategy for keeping older adults healthy. The cumulative effect on the overall health of the individual is a lot more than the sum of its parts. And given that we are dealing with an ageing population, it is really important that we must start implementing these kinds of models into our public health policy. The main findings of the reviewed studies are summarized in Table 1.

Table 1. Summary of physical activity interventions and their effects in older adults

Type of exercise	Main outcomes	Key benefits
Aerobic training	Improved cardiovascular fitness	Reduced blood pressure, better endurance
Resistance training	Increased muscle strength	Prevention of sarcopenia
Aquatic exercise	Reduced joint load	Improved mobility, pain reduction
Balance training	Improved stability	Reduced risk of falls
Group exercise	Psychosocial improvement	Reduced loneliness, better adherence

4. CONCLUSION

Physical activity really is the foundation of spa-based rehabilitation for older adults. Supervised, individualized exercise programs can make a huge difference when it comes to people maintaining their independence, keeping their disability from getting worse, and just

generally improving their quality of life. In the future, researches should focus on figuring out how to tailor these kinds of programs to the unique needs of people who are dealing with multiple health issues.

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The authors declare that they have no conflicts of interest, competing financial interests or personal relationships that could have influenced the work reported in this paper.

Data and materials availability
All data associated with this work are present in the paper.

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