FOOTBALL AS PREVENTION AND TREATMENT

A White Paper focusing on 10 non-communicable diseases and risk factors

S Bennike, TR Andersen and P Krustrup (eds.)

DANSK BOLDSPIL-UNION
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INTRODUCTION

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In 2018, the Danish Health Authority published its report 'Fysisk træning som behandling' (Physical exercise training as treatment), which focused on 31 different disorders and risk conditions. The report begins by emphasising that considerable knowledge has been accumulated on physical exercise as treatment for a wide range of diseases. This also includes diseases that do not primarily manifest as musculoskeletal disorders.

In relation to health, prevention and treatment, football, like physical activity, is the subject of extensive research activity both nationally and internationally, and has resulted in more than 200 research articles and, most recently, the research-based book 'Football as Medicine – Prescribing Football for Global Health Promotion' (Krustrup & Parnell, 2020).

This publication will provide an overview, of the results and conclusions from the scientific literature discussing on football as a form of health promotion, prevention, treatment and rehabilitation.

The White Paper begins with a chapter that focuses on football training as physical exercise and presents the characteristics of football as broadspectrum training that help to improve health. This is followed by ten chapters, each focusing on a specific disorder or risk

condition. The White Paper concludes with a chapter that outlines the need for research in areas that still appear to be inadequately researched.

Each chapter presents the scientific evidence for football as prevention and treatment. Additionally, each chapter is accompanied by a case study related to the disorder or risk condition in question.

Since 2007, the Danish Football Association has been working in collaboration with universities, foundations, NGO's, patient associations, municipalities and – not least – clubs to develop and launch initiatives in relation to health promotion, prevention, treatment and rehabilitation. A number of these are presented in the White Paper, including 'Football Fitness', 'Football for the Heart', '11 for Health', 'Football Fitness After Breast Cancer (ABC)', 'FC Prostate', 'OMBOLD (Football for Socially Deprived)' and 'FC Dementia'.

This White Paper is edited by Head of Research Søren Bennike, postdoctoral researcher Thomas Rostgaard Andersen and Professor Peter Krustrup and published by the Danish Football Association and the University of Southern Denmark in an anthology format, with relevant researchers contributing in their respective fields.

FOOTBALL AS BROADSPECTRUM FITNESS TRAINING

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Introduction

Football training with emphasis on fun, social interaction, fitness training and health was introduced to a number of Danish football clubs in 2011, under the name Football Fitness. This activity, which is based on a solid scientific foundation, is an effective form of exercise to improve physical fitness. This includes cardiovascular, metabolic and musculoskeletal fitness (1).

A number of scientific studies have shown that Football Fitness is a relevant, health-promoting supplement to elite and grassroots football (2,3). The Football Fitness concept has since undergone further development and adaptation for different population and patient groups (1,4-7) and with specific educational programmes in Football for the Socially Deprived and Mentally Vulnerable, Football for the Heart and FC Prostate.

Using Football Fitness as a case study, this chapter describes football training as physical exercise; including how football training can be adapted to different target groups and ensure an effective, fun and engaging workout that most people can participate in. While adapting the training is important, several studies also show that team sports have plenty of potential to build social bonds and thus committed communities. This is crucial for adhering participants for long term training (8-11).

Football activity patterns and exercise effects

Football naturally includes a wide range of varied movements that involve most of the body. As people play football, their activity frequently alternates between walking, jogging and fast running. They accelerate and decelerate, change direction and dribble the ball. They kick the ball at the goal, pass it and balance. Some target groups use both their feet and their bodies to tackle, and they jump as well (12,13).

As a result of this versatile activity pattern, the game of football is a form of exercise with elements of endurance training, interval training and strength training. This has been proven to lead to beneficial and wide-ranging effects on physical fitness and health profile (1,14). See the Football is Medicine model at the end of this chapter.

A one-hour Football Fitness training session typically consists of a warm-up, exercises and games with the ball, as well as games on smaller pitches. Anyone completing one hour of training typically covers a distance of between 2.5 and 5.5 kilometres. It is estimated that 2100-3000 kJ of energy per hour is used, and that the average heart rate during games is typically 80 to 90% of the maximum heart rate (15). This heart rate range is categorised as moderate to high intensity. Together with lower intensity periods and the entire length of the training session, it can be categorised as endurance training. Endurance training has positive effects on metabolic fitness, including the development of the muscles' ability to metabolise sugar and fat, the development of new blood vessels and the regulation of blood pressure (7).

Interval sessions with frequent, fast runs and sprints provide periods in which the heart rate is above 90% of the maximum heart rate (10-50% of playing time), which is categorised as high intensity or HIIT training (High Intensity Interval training). In particular, this has positive effects on the cardiovascular system and metabolic fitness (1).

Fast running, acceleration, deceleration, changes of direction, passing, kicking, jumping, etc. have a positive effect on muscles and bones. And the impact on the bones in the body comes from different directions and with differing intensity because of the varying activity patterns. It has been shown to be highly effective in stimulating bone growth. Similarly, for untrained people the load on the muscles is enough to stimulate muscle growth (1,14). The heart rate is typically slightly lower during warm-ups and ball exercises than during small-sided games, while the content of the other elements of the training session can determine the impact on the other parameters. For instance, a passing exercise will include a lot of passing and kicking and so provide stimuli for the balance and bones, while a catching game will involve fast running, acceleration, deceleration and changes of direction, which can also have effects on musculoskeletal and cardiovascular fitness (15).

Overall, football training has the potential to increase fitness, improve heart health, burn calories, regulate blood pressure, improve balance, increase bone mass and bone density, and increase muscle strength and muscle endurance. All of these physiological adaptations have a significant impact on a number of the most common risk conditions and diseases discussed in the following chapters (1,7,14,15).

Focus on organisation

To make football appropriate and accessible to a wider target group, it is important to organise the game to make it inclusive and ensure it is adapted to the people taking part. Compared to elite and grassroots football as we know it, Football Fitness training is organised with football games so that teams have fewer players and games are played on smaller pitches, with less game time (2). For target groups with specific needs, training can be organised accordingly. For instance, tackling and shoving can be banned for older people or patient groups (such as people aged 55-80 with prostate cancer) with reduced balance and bone strength. Rules can be defined for the same reason for similar target groups, stating that the ball must not be stopped by stepping on it, as this increases the risk of falling or twisting an ankle or knee. But regardless of age group and previous experience of football and organisation, a high heart rate and activity level can be achieved that is considered to promote health (12).

A number of studies have examined the impact of the various formats of football games. These studies show that the heart rate load is high, regardless of whether people are playing 3v3, 5v5 or 7v7. The immediate physiological response to the game types is comparable as long as the pitch size is adjusted to the number of players (80 m^2 per player) (16). However, it should be noted that the fewer players there participating, the more accelerations and changes of direction there are per player, as well as more touches of the ball and involvement in the game. Playing with a fixed pitch size (such as a futsal pitch or handball court – 40x20m) but with different numbers of players will affect the intensity. Having fewer

players means more space per player, which increases the number of fast runs and accelerations, anaerobic energy metabolism and heart rate load. Having more players has the opposite effect (17). Players also perceive games with fewer players to be harder. Adjusting the organisation of the game allows the amount of space to be taken up by different elements of the game to be influenced. You can have fewer players on the pitch and increase the size of the pitch if you want an intense game with lots of touches of the ball. Conversely, the load and intensity of the game can be reduced by making the space smaller and increasing the number of players. While you may think that people will be motivated by getting a lot of action on the ball and a high level of involvement in the game, this may be overwhelming for beginners: they often need to be able to take part in the game and step back on their own terms. That is why it is important to adapt the game of football to the premise of participation.

Football as a form of exercise has a great deal of potential to help improve the health of the general population, and of several patient groups. Football is also a sport that is familiar to most people; and with a network of clubs all over the country, people do not have to go far to find an opportunity to play. However, in larger towns and cities, access to pitch facilities may be limited by youth and senior teams from traditional football clubs; particularly in the afternoons and evenings. Conversely, in larger towns and cities there are a number of caged pitches – smaller pitches with boards and nets around them to keep the ball in play – that can be used for small-sided games. Here, studies also show that the heart rate load and energy turnover are high despite the limited movement speed (18,19), although games in larger areas with higher running speeds and more continuous running activity are preferable (20).

The social perspective of football

The potential of football as an activity promoting health can also be found in the fact that participation is associated with improved social and mental health, as the activity offers a social, meaningful and engaging environment. These increase social capital and long-term adherence to the activity (21). Untrained people or people unaccustomed to sports may think football seems like a tough and violent game, or you may have unpleasant memories of playing football at school or during your teenage years. Moreover, football is inherently competitive in nature and some people may find the competitive element exclusionary (21). It is important to point out that football, organised as Football Fitness and adapted to specific target groups, is significantly different to the traditional organisation familiar from elite and amateur football clubs and how football is perceived in the media (2,3). With Football Fitness, games are not played with a view to selection as one of the starting eleven, and as a rule there is no competition against other clubs. Football Fitness involves sharing the joy of moving with and around the ball. It involves creating social capital between players (22,23). It involves the sense of community that team play offers, and improving activity levels, physical fitness and health profile with like-minded people (2).

Football is Medicine model

Krustrup and Krustrup (14) present a holistic model that summarises the training components of Football Fitness, the training-induced adaptations in fitness and health variables, the link between training stimuli and cardiovascular, metabolic and musculoskeletal fitness, and the relationship to lifestyle-related diseases. The use of Football Fitness in the prevention, treatment and rehabilitation of lifestyle-related diseases, as well as the psychosocial elements and the possibility of creating adherence to an active lifestyle are also incorporated into the model.

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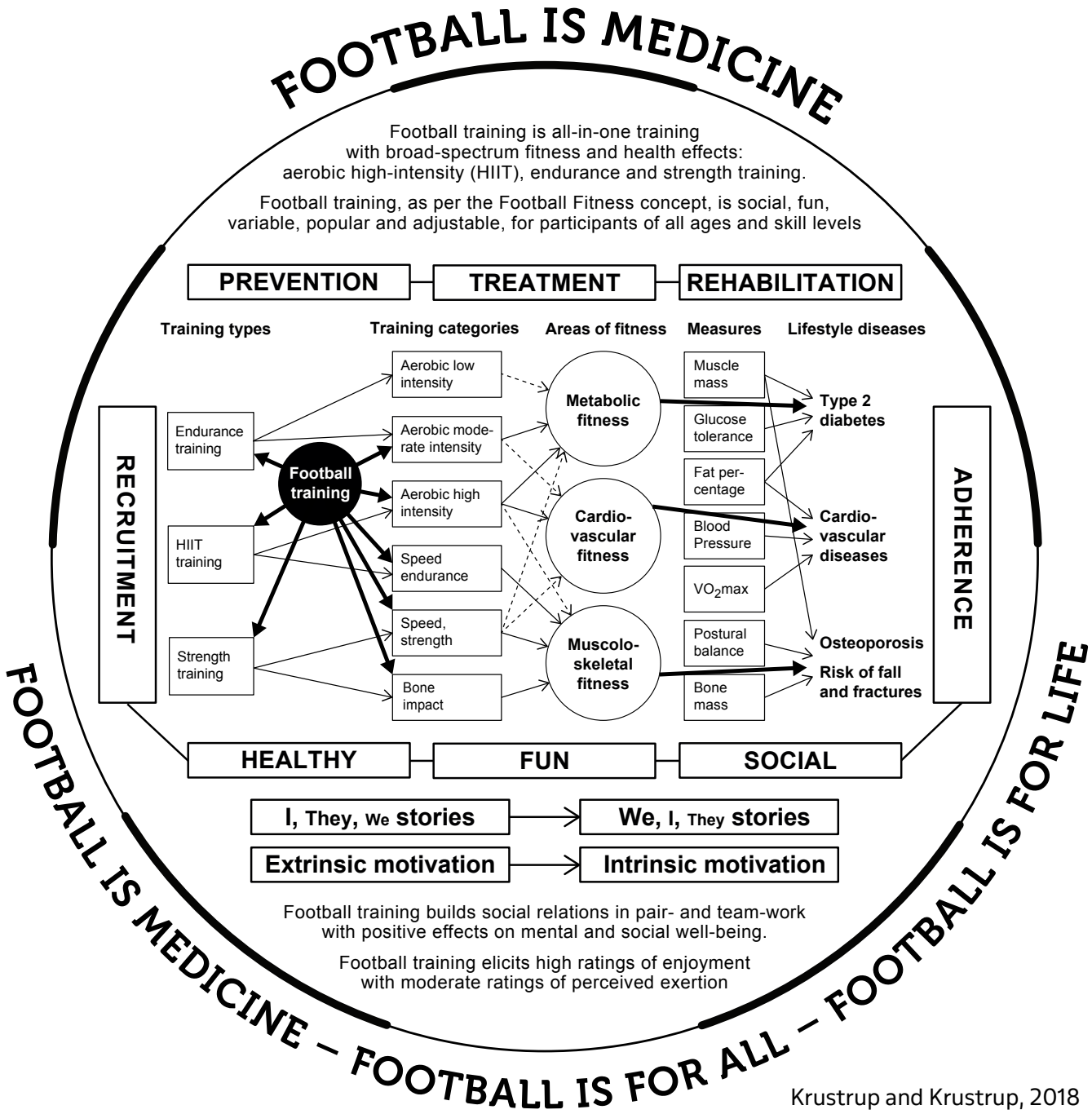

Krustrup and Krustrup, 2018
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FOOTBALL FITNESS AND RECREATIONAL FOOTBALL

'Football Fitness' and recreational football combine the popular ball game with the flexibility of fitness sport and are healthy, enjoyable and social.

'Football Fitness' and recreational football are concepts that can be developed and customised for individual football clubs and teams. This means that the overall framework is fixed – but the practical implementation is flexible and can vary from club to club.

Essentially, a training session consists of a combination of football training exercises, fitness exercises, small-sided games and other games, as well as internal team matches on small pitches with a small number of players on each team. The combination of the many different types of training has a positive impact on the health of players. Research shows that football training is one of the best forms of exercise, improving physical fitness and preventing lifestyle diseases.

Traditionally, women's or mixed teams have been known as 'Football Fitness' teams, while men-only teams are often referred to as recreational football teams, but there are many other names for the same thing. The important thing is that this is a team for people who enjoy exercise, where everyone can join in regardless of level or fitness and where nobody is expected to take part in tournament matches.

Besides playing with the ball, the social aspect is important to many of the players as well. It is easier to turn up for training when good relationships have been forged and people are part of a team.

Football Fitness was launched in 2011 and is a collaboration between the Danish Football Association, the University of Southern Denmark and the University of Copenhagen. Today, it is integrated into many clubs all over the country. Football Fitness has been supported by strong partnerships with the National Olympic Committee and Sports Confederation of Denmark (DIF), Nordea-fonden and, later, as an initiative under the vision 'Bevæg dig for Livet' (Move for Life).

If you would like to know more about 'Football Fitness and recreational football', more information is available on the Danish Football Association website. You can also view about the 'Football Fitness' coaching course.


SELECT

1. HYPERTENSION

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Introduction

High blood pressure (hypertension) is a common condition affecting around 20% of the adult population in Denmark, and more than 250,000 Danish people have high blood pressure without realising it (1). High blood pressure significantly increases the risk of developing cardiovascular diseases such as atherosclerosis, heart failure and blood clots in the brain and heart. The high blood pressure risk condition has a major impact on public health in Denmark.

High blood pressure can be defined in a number of ways, but most commonly as systolic (the heart's pumping phase) and diastolic (the heart's relaxation phase) blood pressure above 140/90 mmHg. However, it is important to point out that major meta-analyses have described a linear relationship between reduced blood pressure and reduced risk of dying from cardiovascular disease at blood pressure as low as 115/75 mmHg (2). A decrease in systolic blood pressure of 20 mmHg or a decrease in diastolic blood pressure of 10 mmHg is associated with a 50% reduction in the risk of dying from cardiovasccular disease (3).

50% reduction in the risk of dying fromcardiovascular disease (3).

There are several causes of high blood pressure, heredity, age and lifestyle being the most significant. It has been well known for decades that regular physical activity and a high fitness level prevent high blood pressure (4), and that regular physical exercise as well as cardio training, strength training and a combination of both are recommended to prevent high blood pressure and as an important element in the treatment of high blood pressure (5). In fact, regular and effective physical exercise is as effective for patients with mild hypertension as antihypertensive tablets, with an average decrease in mean arterial pressure of 10 mmHg (1).

However, it should be emphasised that the exercise effects are dependent on the type of training. For instance, moderate and high-intensity cardio training (such as running) offers greater blood pressure-lowering effects than low-intensity endurance training (such as walking or strength training). More recent meta-analyses have also found the greatest antihypertensive effect of combination training (multiple forms of exercise in the training programme) and hybrid training (multiple forms of exercise in the same training session) (6).

Football to prevent high blood pressure

It has been almost 20 years since a pilot study indicated that football training has a noticeable effect on blood pressure in untrained adults – even those with limited football experience and skills. The pilot study showed that blood pressure fell by 7/10 mmHg after 3 months of football training in 35 untrained men aged 19 to 35 from FC Zulu, Hjemløselandsholdet (the Homeless National Team) and a Serie 5 team (7). Since then, at least 30 controlled, randomised trials have been conducted on the effects on blood pressure of football training for untrained children and adults, older people and various patient groups. In a 2019 meta-analysis which included 31 scientific studies of recreational football, 17 of which described blood pressure effects, it was concluded that 3 to 6 months of two

weekly 45 to 60-minute training sessions resulted in a 4/4 mmHg decrease in blood pressure for untrained adults with normal blood pressure (normotensive) compared to inactive controls; and as much as 10/7 mmHg for untrained people with prehypertension (prehypertensive) (8).

Interestingly, the preventive effect of recreational football training occurs with a modest amount of training (2 x 45-60 minutes per week) in a relatively short time (12-16 weeks). Among many examples are trials involving 12 weeks of training for untrained normotensive men aged 20-43 (8/5 mmHg: 9), 16 weeks of training for untrained normotensive women aged 20-45 (7/4 mmHg; 10) and 11 weeks of training for normotensive schoolchildren aged 10-13 (4/1 mmHg; 11). A review article on the broad-spectrum health effects of football training for women aged 18-75 years concluded that the effect of 12-16 weeks of recreational football on mean arterial pressure is in the order of 2-5 mmHg for normotensive women and about twice as much for women with mild hypertension (12).

Besides a large number of controlled, randomised trials, a few pragmatic field studies have also been conducted. In the Faroe Islands, a nationwide Football Fitness project was implemented where as many as 741 adults (95% women, corresponding to 4% of all women in the Faroe Islands) started playing in 19 local football clubs. After 18 weeks of training (2 x 60 minutes per week), an overall decrease in blood pressure of 4/2 mmHg was observed, the decrease for the group of people aged 20-39 years being similar to that of the 40-72 years group. The study also showed a significantly greater decrease in blood pressure of 8/5 mmHg for the third of participants who had a high baseline mean arterial pressure above 100 mmHg (13).

Football as treatment for high blood pressure

In 2010, the first randomised trials involving participants with mild hypertension. One trial was conducted in Denmark for men aged 31-54 (14)m and one in Switzerland with men aged 25-45 (15). In the Danish study, participants' blood pressure fell by 12/7 mmHg after 3 months (14) and by 13/8 mmHg after 6 months (16), which was significantly more than a control group that received GP check-ups and lifestyle advice on diet and exercise. In the football group, no fewer than 75% of participants were no longer hypertensive after 6 months of training (16). The Swiss study found a similar decrease in blood pressure of 11/9 mmHg, but only the change in diastolic blood pressure was statistically different from the inactive control group.

Since then, a number of studies have been conducted in women with high blood pressure and type 2 diabetes patients of both genders (12,17). After 15 weeks of football training for untrained women aged 35-50 years (2-3 x 1 hour per week), there was an average decrease in blood pressure of 12/6 mmHg, which was significantly more than two swimming groups and an inactive control group (17). This effect was later found to be maintained after 1 year and even 9 years for the women who continued to play football, with the participants not experiencing the expected negative effects of menopause on body weight, fat distribution and cholesterol levels (18).

A 2019 meta-analysis found that football training for 12-26 weeks (on average 2 x 1 hour per week) results in a blood pressure drop of 11/7 mmHg in adults with mild hypertension (8). Compare this to the fact that antihypertensive therapy with tablets causes a corresponding 10 mmHg reduction in systolic blood pressure (3). Such a blood pressure reduction can be described as significant and can be ascribed great clinical importance, as it significantly reduces the risk of heart attack, stroke and death in large population studies (3).

Finally, it should be noted that some studies involving subjects who were already on medication for high blood pressure, did not always show a decrease in blood pressure after physical exercise (19). This may be because this group of people, who are typically treated with ACE inhibitors, already had well-regulated blood pressure.

Conclusion and final remarks

It has long been recognised that physical activity is an important component in the lifestyle-related prevention and treatment of high blood pressure, and the last 15 years of research has shown that football training is a form of exercise that triggers significant positive effects on blood pressure in children, untrained adults, older people and various patient groups. This is partly due to the fact that football training is what is known as hybrid training that includes endurance training, intense interval training and strength training in one and the same training session, and partly because the exercise effects are independent of gender, age and previous football experience. Additionally, there are some interesting opportunities to achieve long-term effects from football training, as the retention element is positively influenced by the motivational and social elements of football.

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FOOTBALL FOR THE HEART

'Fodbold for Hjertet', or Football for the Heart, is recreational football with proven health benefits for Danish people with cardiovascular disease, diabetes and other lifestyle diseases.

High blood pressure is one of the most common causes of cardiovascular disease and increases the risk of blood clots.

According to the Danish Heart Foundation, more than half a million Danish people are living with cardiovascular disease. Football can make a positive contribution in disease prevention and treatment.

'Football for the Heart' is a training programme for people suffering from cardiovascular diseases and people with chronic cardiovascular lifestyle diseases, as well as people at risk of developing cardiovascular disease. This programme supports municipal rehabilitation for heart patients and is helping to prevent the growing number of people with cardiovascular disease.

Studies show that recreational football such as 'Football for the Heart' can have a wide range of beneficial effects on players' health, having a positive effect on aspects such as fitness levels, blood pressure and muscle strength. Not only can recreational football improve quality of life here and now, it can also be a good investment in preventive health for the many people suffering from cardiovascular disease, diabetes and other lifestyle diseases.

Recreational football offers major potential in retaining players. This is partly due to the excellent team spirit encountered by players when they become part of a community, as well as the fact that the training is customised to each individual. Team trainers are also trained to be considerate and create exercises and workouts that suit everyone.

The 'Football for the Heart' concept is based on the principles of 'Football Fitness' and is designed for everyone, from beginners to seasoned footballers.

There are 'Football for the Heart' teams in more than 20 municipalities all over Denmark, and more are being added all the time.

The Danish Football Association, the University of Southern Denmark and the Danish Heart Foundation are responsible for 'Football for the Heart'. The project was made possible by TrygFonden through financial support provided between 2019 and 2022. Researchers from Herlev-Gentofte Hospital are also participating in the development of activities and follow-up research.

If you would like to know more about 'Football for the Heart' and the 'Football for the Heart' coaching course, more information is available on the Danish Football Association website.

2. TYPE 2 DIABETES

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Introduction

Type 2 diabetes (T2D) has attracted increasing attention in recent decades due to an increase in the number of cases and a high mortality rate within the patient group. Globally, an estimated 537 million people have diabetes and this number is expected to reach 783 million by 2045 (1). The majority (≈90%) of these patients have T2D, while the rest have other types of diabetes (such as Type 1 diabetes). In Denmark, around 300,000 people have T2D (2). Additionally, an estimated 60,000 people are living with the disease without knowing they have it. About 290,000 Danish people are thought to have prediabetes, which is a precursor to T2D (3). People with prediabetes have a 70% risk of developing T2D later in life unless significant lifestyle changes are made (4).

T2D is primarily characterised by the reduced ability of insulin to signal the uptake of sugar in muscle and fat tissue and in the liver. This is known as insulin resistance and is an effect of obesity and inactivity, among other things. When the action of insulin is reduced, more insulin from the pancreas is needed to maintain beneficial blood sugar levels. At some point, it will no longer be possible for the cells of the pancreas to secrete enough insulin, resulting in abnormally high blood sugar levels. That is why optimal blood glucose control is of great importance for the risk, prevention and treatment of T2D. Progressive development of the disease and accompanying disorders are often debilitating and have major human and societal consequences.

Football as prevention and treatment for type 2 diabetes

Glycosylated hemoglobin (HbA1c) describes the level of sugar in the blood over the last two to three months. HbA1c is elevated in T2D patients: a level at or above 48 mmol/mol is diagnostic for T2D, compared to 21-44 mmol/mol in healthy individuals. Levels just below 48 mmol/mol can be a sign of prediabetes. HbA1c can be influenced by physical activity, with levels in people with T2D shown to fall by 0.7%, 0.6% and 0.5% after periods of cardio training, strength training and combined training respectively (5). In comparison, HbA1c with medical antidiabetic treatment (metformin) can be reduced by about 1.1% (6).

Recreational football can also be used to prevent and treat T2D. In line with other studies, it has been shown that recreational football is a high-intensity interval activity with a significant cardio-respiratoryload for people with prediabetes and T2D. Moreover, recreational football is a form of combination training that includes many intense and strength-related activities, such as fast running, kicking and sudden changes of direction. These provide a signifcant stimulus for both muscles and bones (7,8).

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HbA1c is reduced in people with prediabetes after 16 weeks of training (2 gn/week) with recreational football and dietary guidance; and more than with dietary guidance alone. Additionally, HbA1c was found to have fallen below the threshold for impaired sugar tolerance in the football group after the training period (9). Similarly, 12 weeks of recreational football (3 times a week) along with dietary guidance has been shown to be effective in improving blood glucose control in adults with T2D (10). Furthermore, the need for anti-diabetic medication was reduced in the test group of middle-aged men with T2D after 24 weeks of recreational football training (twice a week) (11). Additionally, increased levels of muscle glucose transport proteins have been found in people with T2D after a period of recreational football (7). Therefore, recreational football has a part to play in both prevention and treatment of T2D, and will have an even greater impact in combination with dietary changes (12).

In middle-aged and older people with prediabetes and T2D, playing football 2-3 times a week (45-60 minutes) fitness was improved-by 10-14% over 12-24 weeks and have broad effects on metabolism and cardiovascular health (7,9,10,13).

Overweight, and in particular visceral obesity (fat surrounding the organs in the abdomen) are risk factors for developing T2D. 3.5 kg more fat was lost compared to dietary guidance alone following a 16-week programme of recreational football and dietary guidance in people with prediabetes (9). At the same time, these people experienced a 0.7 kg increase in muscle mass. T2D is associated with a reduction in muscle mass, which is why such an increase has implications for the body's strength, metabolism and blood sugar regulation.

Osteoporosis is more common in people with T2D. There is strong evidence to suggest that recreational football has a positive effect on bone formation in untrained people of all ages (14). Similar effects are seen in studies of people with prediabetes and T2D (7,15).

People with prediabetes and T2D are more likely to suffer from cardiovascular disease than the general population. In women with prediabetes, studies find that mean blood pressure falls by 8 mmHg after 16 weeks of recreational football (9). This is similar to the effect of antihypertensive medication. Similarly, other studies find that the blood pressure of men with T2D improved after 12 and 24 weeks of football training (11). Furthermore, desirable reductions in blood cholesterol have been found in men and women with prediabetes after 16 weeks of playing football twice a week (13).

Conclusion and final remarks

Recreational football appears to increase the capacity of muscles to absorb sugar, reduce the risk of developing T2D and contribute to the treatment of T2D. For people with diabetes, or who are at risk of diabetes, recreational football can be played as small-sided games with numerous formats (3v3 to 7v7), both outdoors and indoors. Participating in recreational football 2-4 times a week for 30-60 minutes per training session is recommended.

Training can be structured with playing periods of 4-12 minutes, with breaks in between. At the start of a training period, it is important to regulate the work-to-rest ratio in order to match the players' physical and technical capabilities, and to promote enjoyment and involvement with the ball. Minor adjustments to the rules ensure that the risk of injury during recreational football is low (16), so groups of different ages, genders, skills and physical abilities can participate easily and safely in the same training session.

It is recommended that patients with diabetes undergo a medical examination before starting a period of recreational football training. People with uncontrolled diabetes, advanced diabetic complications, cardiovascular disease and musculoskeletal disorders have not been included in the completed research studies, and so it is not possible to say whether these people can safely participate in training.

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THE FOOTBALL PITCH IS THE STARTING POINT FOR A HEALTHIER LIFE WITH DIABETES

Michael Steen Larsen he knew he had to change his lifestyle when he was diagnosed with diabetes. That is where football plays a crucial role.

Michael Steen Larsen only found out by chance that he had type 2 diabetes. It was only when he went for a check-up for a new job that he found out he was suffering from the chronic disease.

"Looking back, I can see I was on a bit of a sugar high a lot of the time. But I've never been overweight and I've always lived a relatively healthy lifestyle, so I had no idea I had diabetes," says Michael Steen Larsen.

Additional lifestyle considerations

Nevertheless, the diagnosis made Michael Steen Larsen stop and consider his lifestyle. Because even though he is fine now, he is preoccupied with thoughts of the future.

"With type 2 diabetes, you can pretty much live a normal life if you take your medication. But if you want to living like that when you're 80, you need to maintain a healthy and active lifestyle," he says.

Michael Steen Larsen played football when he was a young man. That was why he didn't hesitate to accept the offer to take part in a football training programme for diabetics. He plays football with others with the same disease twice a week, while a team of researchers monitor them and their results.

The effects of the weekly training sessions as part of the project – both the physical measurements and on the pitch – quiickly became apparent to Michael. This project is the first to investigate the health effects of football training in patients with type 2 diabetes.

"There were clear improvements. I used to travel a lot and eat out a fair bit. So while I wouldn't say I was living an unhealthy life, I was maybe enjoying a bit too much red wine and not getting enough exercise. Football changed all that," he says.

Springboard to an active life

Michael is now 63 years old. And even though football is no longer a regular part of his life, the sport has provided an important stepping stone that will allow him to continue leading an active lifestyle.

"You have to get the most out of life for as long as you can. That's why you need to keep moving. Otherwise you age far too quickly," says Michael Steen Larsen.

However, he still enjoys the sense of community in football to this day. He is still in touch with several of the people who were part of the team back then, and they have helped him learn more about his diabetes.

3. CARDIOVASCULAR DISEASE

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Introduction

Cardiovascular disease (CVD) includes a range of conditions such as coronary atherosclerosis (coronary artery disease), heart failure, heart rhythm disturbances (arrhythmias), stroke and heart valve diseases. Every year, more than 55,000 Danish people are diagnosed with CVD and more than 500,000 Danish people are living with these diseases, which often result in reduced physical capacity, breathlessness on exertion and chest pain, reduced quality of life and premature death (1).

Up to one in five Danish people die from CVD, which is equivalent to about 12,000 per year; and both mortality and morbidity of CVD are higher in men than in women. However, people is now living longer than they used to with CVD, and most patients are older as age is the biggest risk factor for CVD. This group of people are often frail and have other conditions in addition to the traditional risk factors for CVD that include, for example, physical inactivity, smoking, overweight, diabetes, high blood pressure and high cholesterol levels.

The value of increased physical activity is well established in both primary prevention of CVD and secondary prevention in patients who already have CVD (2,3). There is significant social inequality in the prevalence and morbidity of CVD, so Danish people with low educational levels, for example, have twice the risk of developing CVD and up to three times the risk of dying from a heart attack than individuals with higher levels of education (1). This inequality is not least due to the increased prevalence of risk factors such as smoking, overweight, unhealthy diet, physical inactivity, sleep problems, stress and loneliness among people with low levels of education or those outside of the labour market. Accordingly, increasing physical activity is just one of many components in a multidisciplinary approach to the prevention and treatment of CVD.

Football to prevent cardiovascular disease

In general, all the well-established beneficial effects of 'unspecified' physical activity (which in population studies is frequently measured in terms of time spent on low or high levels of activity) can be directly transferred to football. It is, of course, also not feasible to conduct large randomised trials of football vs. no (or other types of) exercise with a view to investigate, for example, differences in heart attack rates or mortality. However, football is a universally recognised team sport that combines endurance, strength and high-intensity interval training and may have advantages over other forms of physical exercise for the prevention and treatment of CVD (4-7).

Thus, there is solid evidence that football has beneficial effects on a wide range of risk factors for CVD in young people, the elderly, the sick and other vulnerable groups, as well as beneficial social psychological effects (4-10). The latter can help maintain exercise over time, which is a prerequisite when it comes to reaping the benefits in terms of prevention and treatment of CVD.

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European guidelines for the primary prevention of CVD recommend that adults get at least 150-300 minutes of physical activity as moderate-intensity endurance training or 75-150 minutes of vigorous-intensity exercise per week. Additionally, strength training is recommended at least a few times per week (2). The threshold for how much physical activity is needed to reduce mortality and the risk of CVD is relatively low, but there is a dose-response effect, which means that the more exercise people do, the better it is for their heart health and longevity. Furthermore, individuals at highest risk, including those with multiple risk factors for CVD or with established CVD, have the most to gain from targeted prevention and treatment (including physical activity), precisely because they are inherently at higher risk of the disease.

Football training has been shown to have beneficial effects on the physical capacity (fitness), blood pressure, resting heart rate, heart function, muscle strength, fat mass, and cholesterol and blood sugar levels in adult men and women of all ages and health profiles (4-9). In randomised trials, the effects of football training were on a par with or better than the effects of moderate-intensity endurance training (such as running), and there were no significant injuries. For instance, a major study showed that football training lowered systolic blood pressure by 11 mmHg in people with mild hypertension (4). In population studies with blood pressure medication, such lowering of blood pressure has led to significant reductions in the risk of heart attack, stroke and death (11). Additionally, cardiac benefits of football training in schools have been identified in healthy or overweight children aged 8-12 years (10,12-14).

Football to treat cardiovascular disease

Patients with CVD should generally exercise most days of the week, and preferably for at least 150 minutes a week at a moderate intensity level (3). Physical exercise is part of the rehabilitation program after hospitalisation for many patients with CVD, and the need for medical screening of patients with CVD before participation in physical exercise is determined by their physical status, disease category and training type, respectively (3).

However, for stable patients with well-treated CVD, any minimal risk from physical activity is greatly outweighed by the massive health benefits. In particular, the beneficial physiological effects are documented for the major patient groups with coronary atherosclerosis and heart failure, including favourable effects of endurance and strength training as well as high-intensity interval training, the latter of which may be more effective and motivating for certain patient groups (3,7,15).

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Randomised trials of shorter duration of structured physical exercise vs. no exercise in patients with CVD typically show increases in fitness, decreases in risk factors (such as blood pressure and cholesterol levels) and improved heart function, while population studies indicate that physical exercise in patients with CVD results in decreased mortality, a reduced need for hospitalisation and improved quality of life (3,16,17).

The specific value of football training in comparison to other forms of physical exercise has been studied to only a limited extent in patients with clinical CVD, except for those with hypertension. However, as indicated previously, football has well-documented beneficial effects on numerous risk factors for coronary atherosclerosis and heart failure, including low heart rate, high resting heart rate, high blood pressure, overweight, and high cholesterol and blood sugar levels in untrained adults, as well as the elderly and patients with high blood pressure and type 2 diabetes. Many of these people have subclinical CVD, and type 2 diabetes which is, in fact, considered a risk factor on par with already established coronary atherosclerosis. Consequently, football can be recommended as a training modality in the treatment of patients with CVD (4-9).

Conclusion and final remarks

Football is a beneficial form of physical exercise for the prevention and treatment of CVD. In patients with CVD, the condition must be stable, i.e. with no new symptoms (chest pain, worsening shortness of breath, fainting, etc., symptoms at low load or at rest, recent hospitalisation, severe frailty, etc.) Football training in patients with CVD should usually be started in a structured setting (such as during rehabilitation after hospitalisation), but in general the benefits of physical exercise greatly exceed any minimal risk.

Future research in this field aims to strengthen the evidence for the value of football training in the prevention and treatment of CVD so that football training can be integrated into prevention and rehabilitation initiatives.

The evidence-based and well-validated 'Football for the Heart' concept can be recommended as a usable tool in this implementation process.

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FOOTBALLER WITH NINE PREVIOUS CARDIAC ARRESTS PLAYS 'FOOTBALL FOR THE HEART'

Ms. Lisbeth Houmann rarely sits still. She swims, does strength training, goes walking and plays football.

In other words, she likes to be active and keep moving. Or, as she herself puts it:

"I've probably always had ants in my pants. I really try to live my life."

And when you have faced death like Lisbeth Houmann has, you really need to grab life with both hands. 65-year-old Lisbeth Houmann has had no fewer than nine previous cardiac arrests. She had the first one in 2019, followed by two the next year, and in 2022 she had six cardiac arrests one after the other.

"Dying doesn't hurt," she says. "It hurts afterwards."

That is why an active lifestyle, and, in particular, the 'Football for the Heart' football team, is an important part of Lisbeth Houmann's life.

"Football is really, really important. It can do so much more than other things. There are times when I feel that strength training, football, and swimming all in one day is a lot. But I don't want to have to go without my football."

Having a laugh on the pitch

When Lisbeth Houmann meets up with her football team at 'Football for the Heart' at Lyngby Boldklub on Wednesdays, the emphasis is not on kicking technique, dribbling, or scoring the most goals. The players turn up faithfully in all weathers, and even rain and low temperatures do not stop their weekly training sessions.

"We get lots of fresh air, laughter and fun and really enjoy all the fellowship on the pitch where we fool around. It is an effective workout where we get moving and get our heart rates up, and we have a lot of fun. There are not many sports that do exactly that."

Lisbeth Houmann had not had all that much experience on the football pitch when she began her football career with 'Football for the Heart' in 2019. But she was given information about 'Football for the Heart' as part of her rehabilitation after her cardiac arrest, and she phoned the team's trainer.

"I'd never played football, but I thought I had to give it a try. I'm the kind of person who loves to try new things, and I've been hooked on football ever since."

Her goal after each of her previous cardiac arrests has been to get back to football and the rest of the team. Lisbeth Houmann feels there's room for everyone, and that people really look out for one another.

Football for the Heart

'Football for the Heart' is a training programme for people suffering from cardiovascular diseases and people with chronic cardiovascular lifestyle diseases, as well as people at risk of developing cardiovascular disease.

'Football for the Heart' has been created as part of a collaboration between the Danish Football Association, the University of Southern Denmark and the Danish Heart Foundation and is supported by TrygFonden. Researchers from Herlev-Gentofte Hospital are also participating in the development of activities and follow-up research.

If you would like to know more about 'Football for the Heart', more information is available (in Danish) on the Danish Football Association website.

4. OSTEOPOROSIS

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Introduction

A healthy bone can typically withstand the mechanical stresses placed on it as we move. Osteoporosis is a disease characterised by reduced bone strength and therefore an elevated risk of bone fractures. The reason for the reduced bone strength is partly a reduction in bone mineral density (BMD) and partly a compromised bone microstructure. In Denmark, the disease affects one in three women and one in six men over the age of 50 (1). It is estimated that approximately half a million Danish people are living with undiagnosed osteoporosis (2).

Hip fractures, forearm fractures and vertebral collapse are the most common types of fractures related to osteoporosis. While the first two fractures typically occur after minor trauma (e.g. due to falls), a vertebral compression fracture is the result of 'fatigue fractures', which develop when the daily mechanical load repeatedly exceeds the strength of the vertebrae. This is why osteoporosis can be characterised as a "silent disease" that is often first discovered when the patient experiences the first fracture.

The incidence of osteoporosis is expected to increase in the coming years due to the increasing life expectancy of the population (3,4). This will mean an increased financial burden on society with reduced quality of life for an increasing number of patients who will become dependent on carers and the health service. The disease can be extremely painful and debilitating, with hip fractures in particular being linked to high morbidity and mortality rates. Primary prevention and health promotion should therefore be a high priority, including community-based training programmes that can strengthen the skeleton, increase muscle strength and improve balance and coordination.

Osteoporosis is diagnosed on the basis of a measurement of BMD (as an estimate of bone strength) determined by Dual-energy X-ray Absorptiometry (DXA scan). Like many other physiological variables, 60-80% of BMD is genetically determined. However, implicit in this is the fact that 20 to 40% of the variation can be attributed to our lifestyles and living conditions; including our levels of physical activity. Epidemiological studies show that bone mineral content (BMC) and BMD increase to a maximum (peak bone mass, PBM) in our mid-twenties, where it reaches a plateau that lasts until we reach the fifties.

Both genders then experience a 0.5-1% decrease in BMD annually, and in women there is an accelerated decrease of 3-6% annually in the first few years after menopause (cessation of menstruation). This, along with a lower plateau, is probably the main reason for the higher incidence of osteoporosis in women compared to men.

Football to prevent osteoporosis

Physical activity and training can reduce the risk of osteoporosis in two ways: through an increase in PBM in childhood and adolescence, and through a reduction in age-related bone loss in adulthood. At the same time, increasing muscle strength, dynamic balance and coordination will help to reduce the risk of falls and fractures (2).

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A temporary elastic deformation of the bone occurs when muscle forces or ground reaction forces apply a mechanical load to the bone. The greater the degree of deformation (strain) and the faster the deformation rate, the greater is the bone-building stimulus will be. The physical activity is called high-impact when it takes place at high speed or involves powerful take-offs and landings. And the activity is called odd-impact if it also involves frequent and rapid changes of direction.

"Multimodal training", which alternates between different types of activity such as hopping and jumping, fast running with acceleration and deceleration, and strength, balance and coordination training, is a recommended form of exercise to strengthen bones and prevent fractures (5,6). As these types of activities are common elements in football, it is not surprising that a large number of studies have shown that football promotes bone health and has a bone-building effect in all age groups, based on both bone mass and BMD measurements and biochemical bone markers (7-13).

A meta-analysis has shown that football training in general has both an acute effect on bone modeling and marked exercise effect on BMD and bone strength in the legs (8). Thus, an increased BMD is seen in the legs, hip region and lower back in younger women (9,14), middle-aged women with high blood pressure (11), young men (15), older men (10), people aged 55-70 with prediabetes (16), patients with type 2 diabetes (17,18) and men with prostate cancer (19,20). Several of these groups are atgreater risk of developing osteoporosis due to physical inactivity and/or disease and treatment. Therefore, recreational football will make good sense as part of health promotion and prevention of osteoporosis.

Several paediatric studies also indicate that football training is an effective way of improving bone health in this age group as well. For instance, the "PRO-BONE" study (involving 116 13-year-old boys) compared the bone-building effects of one year of football, swimming and cycling training with an inactive control group and found that the football group developed greater bone mass and bone strength than the other groups (7).
Similarly, a study of 11 weeks of participation in the "11 for Health" football concept showed an increase in leg BMD compared to an inactive control group of schoolchildren aged 10-12 years (21). Finally, a 10-month study of the "FIT FIRST 10" programme, in which ball games were a central component, showed that bone health in children aged 8-10 years was improved (22).

Football to treat osteoporosis

Multimodal intervention studies combining different types of training have identified a bone-building effect in patients (23). Despite the well-documented effects of football training on bone strength and osteoporosis prevention, football does not seem to have been studied as part of treatment. This is probably because there is a potential risk of collisions with other players and falls that can cause bone fractures if the bone strength is low. This is particularly true if dynamic balance, coordination and muscle strength present a challenge for the patient, as well as a lack of overview of the pitch, the ball and other players. Therefore, it seems obvious to screen patients' physical and mental abilities before they start training and to begin the

training period with a basic physical and motor training programme that includes elements that are relevant to football.

Furthermore, modifying the game for treatment purposes is recommended in order to prioritise individual game control and injury prevention. Several reviews and meta-analyses have provided recommendations on how training in general can be arranged for patients with osteoporosis (5,24). These are also relevant in respect of football. For instance, recommendations may include reducing the size of the pitch and number of players, banning tackles, limiting the number of dribbles and implementing "walking football". Furthermore, it would be appropriate for football training to take place in dedicated osteoporosis groups so that all participants have the same need for consideration.

Conclusion and final remarks

The bone-building effect of football training is seen in all age groups, for both genders and in several patient groups. Football training modified to suit the target group therefore offers a great, mainly unexploited, potential in the prevention of osteoporosis, falls and fractures in both the general population and in a number of risk groups. No studies have investigated the effect of football training as a treatment for osteoporosis, as far as we know, but other forms of multimodal training have been shown to have a bone-building effect for this patient group.

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FOOTBALL KICKS MEDICINE BACK ONTO THE SHELF

Osteoporosis is no obstacle to playing football, and 82-year-old Bente Sivertsen is a living example of this.

A team of women aged 60+ play football at Hørsholm-Usserød Idrætsklub on Monday mornings.

At 82 years of age, Bente Sivertsen is one of the oldest members of the team. She has osteoporosis and was taking medication for a long time. But eleven years ago, she decided to take up football. And it was a great success.

"For me, it's incredibly important both mentally and physically to keep moving. That's why it's important that I get to play football with the others," says Bente Sivertsen, who also says she tries to go out walking as often she can.

"I always think it's great to keep moving. It makes me feel better and cheers me up."

Focus on exercise and community

Bente Sivertsen's team is part of 'Football Fitness', which focuses on exercise and community, and this is something the club in Hørsholm is really good at.

"We play for an hour each time, but how everybody wants to spend that hour differs widely. I try to come up with a programme that involves a few different exercises," says Bente Sivertsen.

"We always finish off with tea and coffee and enjoy spending time together. That way, we get plenty of exercise and can really enjoy the sense of community afterwards. We all like to know how the others are doing," she says.

From running shoes to football boots
Bente Sivertsen feels the difference in her body if she does not get to move around, so that has always been a focus for her. Especially considering she has osteoporosis. That is why she bought a pair of running shoes many years ago.

"It was just too damned dull. It didn't take me long to realise that running on my own simply wasn't for me. I needed to spend more time with other people, and so football was the perfect solution for me".

"The weather might not always be at its best, but we go and play anyway because we really enjoy spending the time together. And we always play outdoors, regardless of the weather. But we have a bit of fun with that," says Bente Sivertsen.

Room for more players
Bente Sivertsen says she has experienced first-hand how much of a difference football has made to her illness, and she strongly encourages others to do the same.

"When it comes down to it, there's always room for one more on our team. You don't need to have played football ever before. That has nothing to do with it. We just want you to come and have fun playing football with us, and I promise – you will!" concludes Bente Sivertsen.

5. MUSCULOSKELETAL DISORDERS

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Introduction

Football training arranged into small-sided games can introduce a number of health-related physiological stimuli to the musculoskeletal system. These positive adaptations are probably due to the high number of activity changes (~200) in each training session and a high proportion of high-intensity loadings of short duration (1-4 seconds) on the legs and upper body (such as twisting, deceleration, rapid changes of direction and kicking) (1,2).

All muscle fibre types (I, IIA, IIX) are activated during football training, with a high number of myofibres found to be completely depleted of muscle sugar (glycogen) after training. This indicates a particularly high level of myocellular energy utilization (3). The high levels of whole body activation are emphasised by acutely elevated (+80-120%) intramuscular lactic acid concentrations and marked depletion of muscle glycogen in the knee extensors and shoulder abductors (4). After weeks to months of recreational football training, muscle biopsy data have shown positive adaptations (increased levels of GLUT-4 and oxidative mitochondrial enzymes) in both leg and upper body muscles (5,6,7). At the same time, significant increases in muscle mass for both the legs and the upper body have been demonstrated in response to prolonged periods (4-16 months) of recreational football.

The varied and intense stimulation of the musculoskeletal system not only affects muscle, bone and tendon tissue, but also results in important neuromuscular adaptations (8) as elaborated below. Overall, these effects of football training can help to improve body function and result in significant improvements in the health and risk profile of young, older and untrained individuals (5). This is of relevance to the prevention and rehabilitation of a wide range of disease conditions, many of which are related to a sedentary lifestyle. Similarly, football training and the resulting improvements in body composition and muscle function can help to ensure a healthier ageing process (9).

Football as prevention and treatment of musculoskeletal disorders

DXA scans have shown significant increases in muscle mass after both short and long periods of recreational football training (10). This includes hypertensive middle-aged women (11), men with prostate cancer (12) and people with prediabetes (13). Additionally, significant increases in muscle mass have been observed for the upper body musculature (5). Furthermore, reductions in body weight and fat mass after 4-16 months of training have been observed in overweight middle-aged women with hypertension (11) and middle-aged men with type 2 diabetes (14). These findings consistently show that recreational football can improve the musculoskeletal health profile of both young and middle-aged people, including individuals with high blood pressure and overweight.

Based on muscle biopsy sampling, hypertrophy of the thigh muscles has been reported after 12 weeks of recreational football training in young to middle-aged untrained men (10). This can be regarded as an important adaptation mechanism as maximum voluntary contraction (MVC), rate of force development (RFD) and power are positively correlated with total muscle fibre area (15). The observed increases in the cross-sectional area of muscle

fibres resulting from recreational football are thus expected to result in corresponding improvements in maximum voluntary contraction and RFD/power (16). The proportion of fast-twitch type IIX fibres in the knee extensors was reduced (from 18 to 11%) after 12 weeks of football training, with a trend towards an increased proportion of type IIA muscle fibres (10). This shift in fibre type composition is of important functional significance, as fast-twitch type IIA muscle fibres are significantly more fatigue resistant than type IIX muscle fibres (15,16). Notably, the degree of muscle hypertrophy (+15%) observed after 12 weeks of football training is comparable in magnitude to that observed after 14 weeks of progressive strength training with heavy weight loads (75-90% 1RM) in young men (+18%) (15).

Also of notice, important metabolic muscle adaptations have been observed as a result of recreational football training. Twelve weeks of training resulted in increased levels of mitochondrial enzymes (citrate synthase) and higher numbers of capillaries per muscle fibre in the thigh muscles (7,10). This shows that recreational football can trigger an increased oxidative capacity in the exercised muscle fibres while also allowing for increased muscular blood flow. As a sign of improved muscle fat oxidation capacity, reduced blood lactic acid levels and a lowered respiratory exchange ratio (RER) have been observed during submaximal treadmill testing after 12 weeks recreational football training in untrained men (10).

Finally, older individuals with lifelong participation in football training demonstrated increased amounts of intramuscular biomarkers involved in DNA repair and in the suppression of accelerated ageing, known as senescence (Erk1/2, AKT, mTOR, FoxM1) when compared to untrained, age-matched individuals (17). Overall, the above findings indicates that there is a protective effect on skeletal muscle in older people who participate in chronic (lifelong) football training.

Older, lifelong trained football players also exhibit superior mechanical muscle function (increased MVC strength and RFD) compared to age-matched untrained individuals (18). Comparable effects can be achieved with weeks to months of small-sided football exercise, where maximum voluntary contraction (MVC) of the leg muscles and 30 m sprint capacity were significantly increased in untrained middle-aged men in response to 12 weeks of recreational football training (16). Additionally, increases in MVC and RFD of the hamstring muscles have been observed in older men with an average age of 68 years after 12 months of football training (19). Finally, 12 weeks of football training resulted in increased maximum voluntary contraction (MVC) in the leg muscles in older men with prostate cancer (12) despite concurrent exposure to anti-androgen hormone treatment, with even greater increases in maximal muscle strength observed after 32 weeks of training (20). Moreover, football players with lifelong involvement in football training demonstrate better postural balance compared to untrained peers (18). Improvements in postural balance have also been observed in middle-aged premenopausal women following 16 months of football training (21).

Recreational football training seems to affect the upper body musculature as well. Thus, neck extensor muscle strength increased after 3 and 9 months of football training in female hospital workers (aged 25-63) compared to an age-matched and activity-matched control group (22). After 9 months of football training, reduced muscle pain intensity in the neck

and shoulder area and shorter pain duration were also observed (23). Notably, recreational football appears to cause a faster reflex response (shorter reaction times) in the lower back muscles in response to sudden loads on the upper body (8). This indicates that football training may potentially reduce the risk of lower back injury. Similar findings have been observed in premenopausal women following 16 months of football training (21).

Remarkably, no changes in this reflex response were observed after 3 months of running (8), which suggests that football training may be more effective than running exercise when it comes to reducing the risk of lower back injury.

In older (+65 years) individuals, significant improvements in functional capacity were observed in terms of an increased number of repetitions completed in a standardised 30-second sit-to-stand test from a chair (30-s STS) along with an increased maximum stair climbing speed as a result of 12 months of football training (19). Thus it appears that prolonged periods of football training can be considered an effective intervention strategy to counteract age-related losses in muscle strength and functional capacity (19). Similarly, improvements in functional capacity (30-s STS, stair climbing speed) were noted after 32 weeks of football training in older men with prostate cancer (24).

Conclusion

The training-induced adaptations after shorter and longer training programmes involving recreational football are extremely wide-ranging. Recreational football increases muscle mass and significantly improves muscle fibre function and muscle strength profile regardless of gender or age and even during periods of illness. The observed structural and functional adaptations evoked by recreational football are of great value for both the prevention and treatment of musculoskeletal disorders and are therefore also of important socio-economic relevance.

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FOOTBALL TEAM THE FOCAL POINT IN FREDERIKSSUND

'Momseholdet' has become something of a focal point at Frederikssund IK, where the rules have been thrown in the bin in order to create a team where everyone can join in.

A healthy, fun and sociable way to exercise. These are the focal points when up to 80 men and women meet at Frederikssund IK to play football on Tuesdays and Thursdays.

Rules and tackles are dropped. Instead, the emphasis is on providing an environment where everyone can join in, regardless of gender. This is also part of 'Football Fitness', which can be found at football clubs all over Denmark.

The players on the football team are aged about 60 and above, and it is far from unusual to see men and women well into their 80s on the team – some people even travel all the way from Copenhagen to be part of the team.

Aase Hansen is the team leader and initiator of the team, which will be celebrating its tenth anniversary later this year.

"The most important thing is that everyone can join in and have fun. We're 50/50 in terms of gender, and even though the men and women usually play separately, some women might want to be challenged more and play with the men. And equally, some of the men prefer to play with the women. And that's perfectly fine. All we want is for everyone to be happy," says Aase Hansen.

Football and community

With 80 members on the team, people are facing lots of different physical challenges. For Aase Hansen, she was inspired to start the team when she was diagnosed with high blood pressure. Today, she does not need to take any medication.

There are also several club members with musculoskeletal problems. One of them is Mie Nygaard, who has multiple sclerosis. She can tell how football has made a difference to her.

"Exercise is so important, and having the opportunity to play football and work out every week means so much to me. I can tell I feel better, and I'm sure it's because I can play football," says Mie Nygaard.

"And it also helps me just to be part of a community where there's an understanding that each of us might be facing challenges," she explains.

No second thoughts about football training

It is not always easy for Mie Nygaard to get down to the football club, but she never regrets it when she does finally get there.

Aase Hansen has found that too – she has never experienced a bad atmosphere within the team.

"We get on so well together, and we're good at organising events outside of football as well. If you'd asked me ten years ago, I wouldn't have said I'd be playing football, but now I can't imagine life without it," says Aase Hansen.

Mie Nygaard shares this view and is concerned about how her body would feel without football.

"I'm generally in a good place now, but who knows how things would be without football. It's a good question, and I daren't think about it."

6. OVERWEIGHT AND OBESITY

Malte Nejst Larsen[1], Morten B. Randers[1], Magni Mohr[1,2]
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Introduction

Overweight and obesity occur when energy intake exceeds energy expendure over a period of time. Overweight is linked to a number of serious chronic conditions, including cardiovascular diseases, type 2 diabetes and different types of cancer. Overweight can also affect quality of life, result in reduced mobility and body function, affect self-esteem and lead to depression. That is why it is important to focus on the prevention and treatment of overweight and obesity (1).

The economic costs of overweight and obesity in Denmark are significant, as any who lives with overweight costs society more than twice as much in healthcare costs and about threefold more in welfare payments compared to a person with normal weight (2). Direct costs include the cost of treatment of diseases related to overweight and obesity, which includes medication, hospitalisation, consultations with doctors and specialists, and in some cases surgical procedures. Indirect costs are related to productivity losses and sick leave due to diseases related to overweight and obesity. This includes loss of earnings, as well as increased costs for treatment and early retirement.

Expenditure on prevention and health promotion initiatives aimed at reducing overweight problems in the population also needs to be taken into account. This includes awareness campaigns, health checks, creation of exercise and diet programmes and other initiatives aimed at lifestyle changes.

Football as prevention and treatment for overweight and obesity

There are many factors that place football in a position to deal with the challenges associated with overweight and obesity. Firstly, football requires minimal equipment and can be played at any level, by people of any age. This makes the sport accessible to everyone and it is possible to play almost anywhere, both indoors and outdoors, almost regardless of weather conditions, which allows training to take place with a certain frequency, (such as twice a week all year round). Compared to other forms of training such as interval running and strength training, the high intensity of football can be sustained for longer (typically 1 to 1.5 hours) as the workout is not perceived as strenuous and places people in a good mood (3,4).

This means that the total amount of training, and thereby energy turnover, is high. This creates a good foundation for the energy balance deficit required to reduce excess weight.
It is estimated that the energy turnover during football, organised as small-sided games (such as 5v5 on a 20 x 30 m pitch) is about 2100-3000 kJ per hour, depending on weight, gender and physical fitness. Over a period of 12-16 weeks, this results in a fat loss of 2-3 kg and an increase in muscle mass of 1-2 kg (5). This dual positive effect on body composition emphasises that it may be relevant to measure body fat percentage and muscle mass (or, alternatively, waist circumference) and not solely use weight, height or BMI when evaluating the health effects of exercise, including

football, as there are no guarantees that exercise will lead to weight loss (eg. if the increase in muscle mass matches the fat loss).

Football can help reduce the prevalence of overweight and obesity already from childhood (6); both acutely and by reducing the risk of developing the condition later in life, as there is a strong correlation between childhood overweight and adult overweight (6). Children who participate in football training regularly have a lower body fat percentage and higher muscle mass compared to children who are not physically active (7,8). There is also evidence to indicate that regular participation in football programmes both in and out of school can help to reduce body fat percentage (9,10).

In schools, football classes have been successfully organised and implemented in a way that has been demonstrated to motivate many children to take part by fulfilling the three basic needs of self-determination theory (11). The idea is that there should be a certain level of success for everyone regardless of experience, which means that the technical and tactical demands should not be set too high. There should be social interaction with others, which is ensured by making sure children work together in pairs or small groups. Additionally, children should experience autonomy, which is ensured by creating an understanding of the purpose of the activities and the children's opportunities to influence them. A good example of the latter is that football allows players to decide where to run and who to pass to. Match-like activities should also be conducted in smaller groups, as this has been shown in both club and school football to lead to greater involvement, more appropriate challenges and higher intensity (12,13).

Adults can also both prevent and tackle overweight by participating in football (14), and the principles for organising training appropriately are the same as for children. Adults are also motivated by success, empowerment and a sense of belonging. And as long as the game of football is organised in a way that ensures the number of players matches the size of the pitch and the goals, the training intensity (measured by percentage of maximum heart rate) is also comparably high regardless of whether the target group is children, adults, older adults, beginners, experienced players, men, women, healthy individuals or patients (15,16). Among other things, this enables everyone to achieve high energy turnover, including increased fat metabolism (3), thereby reducing excess fat; a key factor in preventing several diseases.

Furthermore, studies have also shown that groups with high blood pressure, prediabetes, type 2 diabetes and certain types of cancer experience significant fat loss after a period of football training (5,14). This has been demonstrated in a study where football was used in conjunction with dietary intervention for type 2 diabetics (17). They managed to achieve major fat loss of 3.4 kg with football and a calorie-reduced diet without sacrificing muscle mass or participants' functional capacity, including fitness levels. Many other diets leading to significant weight loss also result in significant loss of muscle mass, and therefore reduced performance (18).

Conclusion and final remarks

Football is an effective form of exercise for the prevention and treatment of overweight and obesity, especially when combined with diet. This is due to the high amount of energy used during training, which is possible in high volume, several times a week and for relatively long periods of time, typically 1-1.5 hours, due to its motivational and social nature. This could lead to improved quality of life at an individual level, as well as reducing the cost of treatment and increasing revenue in the form of increased employability at a societal level.

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TEAM SPIRIT CREATES HEALTHY HABITS AND MAKES PEOPLE HAPPIER

At Julemærkehjemmene, "Christmas Seal Homes", football is part of the 'Play and Movement' concept that paves the way for healthier, less lonely lives for children.

"We speak nicely to one another. We treat our opponents with respect, and we don't shout insults at each other," says Søren Ravn Jensen.

He is the director of the Christmas Seal Homes Foundation, where football is often part of day-to-day life. But when the kids head out onto the pitch, being the best player isn't what matters. Instead, they teach one another how to be good teammates and behave fairly towards opponents.

"Here, we head out onto the pitch in order to create a shared victory in a community where everyone helps and depends on one another," says Søren Ravn Jensen.

Active everyday life is key

Every year, the Christmas Seal Homes Foundation helps vulnerable children to cope with bullying, loneliness and unhappiness. Play and movement are an important part of what they do, and they follow the Danish Health Authority's advice of one hour of physical activity every day.

Although children are weighed and measured on arrival and just before they leave, weight is not their primary focus. And there is a very special reason for that.

"Children often come with a lot of other baggage, so we don't talk about the kids being overweight when we work with them. Yet we can see that they lose weight when they're here and their physical health improves," says Søren Ravn Jensen.

Their active lives help to ensure the children enjoy lots of tiny victories during their stay. And these victories do not just impact on their bodies, but on a wide range of other parameters as well.

"We can tell they feel good about themselves. They feel less lonely, they eat more healthily and they sleep better," says the director.

Team spirit comes first

Although the children leave after ten weeks, the Christmas Seal Homes Foundation does not let them go entirely. They help the children to become part of the community and keey an eye on them for up to two years afterwards. Here, the results clearly indicate that healthy habits last.

Søren Ravn Jensen attributes much of the credit to the sense of community provided by a team sport like football.

"There's no doubt that the community makes it easier for them to stick with healthy habits when they leave us. They realise the team can't play without them. They become part of a community where they're needed, and that keeps them coming back to us," says Søren Ravn Jensen.

7. DYSLIPIDAEMIA

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Introduction

Dyslipidaemia, an inappropriate shift in the lipid profile balance of the blood, is usually defined as elevated serum total cholesterol, low-density lipoprotein (LDL) cholesterol and triglyceride concentrations and reduced high-density lipoprotein (HDL) cholesterol (1).

In Denmark, high cholesterol is usually defined as when serum LDL cholesterol is higher than 3 mmol/L and other heart disease risk factors are also present, which is the case for more than 2 million Danish people. LDL cholesterol plays a key role in the accumulation of cholesterol in the arterial walls, and elevated serum LDL cholesterol is a primary cause in the development of atherosclerosis (2). This is why reducing serum LDL cholesterol is a primary goal in the clinical treatment and prevention of atherosclerosis-induced cardiovascular diseases, especially heart attack, stroke and peripheral artery disease. It should be mentioned that LDL cholesterol particles come in different sizes, which also plays a role in their harmful effect. Pharmacological treatment with statins effectively reduces serum LDL cholesterol (26-35%) and total cholesterol (20-25%) and reduces the risk of atherosclerosis-induced cardiovascular disease by 31% (3).

Another effective treatment is physical exercise, which reduces serum LDL cholesterol concentration and has a number of other beneficial effects in preventing cardiovascular disease (4). Thus, the overall evidence suggests that a combination of exercise (strength training, endurance training, etc.) is most effective in reducing LDL cholesterol concentrations (5).

Football as prevention and treatment of high cholesterol

Football combines endurance training, high-intensity interval training (HIIT) and strength training, making it a "hybrid form of exercise" with broad spectrum effects on markers of metabolic health, cardiovascular capacity and skeletal muscle function (6).

In a 1-hour recreational football training session, each player moves a total distance of between 2.5 and 5.5 kilometres depending on the target group and pitch size, while the average heart rate during small-sided football for untrained people and patient groups is 80-90% of maximum heart rate (6). Similarly, the energy used is estimated to be around 2000-3000 kJ per hour, with significant fat burning (6).

It has also been shown at meta-analysis level that football training for 1 hour twice a week for 12-16 weeks results in a reduction in body fat of ~2 kg for untrained people and different patient groups (7). Additionally, studies show that the capacity of muscles to burn fat is improved (8).

In the more than 40 scientific studies conducted up to 2023 that used football as an exercise intervention for untrained adults, serum cholesterol was measured in 12 of the studies. These are typically exercise interventions lasting 12-16 weeks, with some exceptions where the intervention lasted from 6 months to 9 years. Several of the studies completed have been compiled in a meta-analysis, analysing the effects of football training on blood lipids (7).

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The effect on LDL cholesterol was classified as favourable, with an average decrease of 0.21 mmol/L, which can be considered clinically relevant in reducing cardiovascular disease (3,9). They also found decreases in total cholesterol and triglycerides of 0.13 and 0.15 mmol/L, respectively.

In 2009, a study showed that plasma LDL cholesterol decreased by 15% in healthy, untrained young men after a period of football training (10). A similar decrease has been observed in healthy young women after 16 weeks of training (11). Furthermore, a decrease of 0.4 mmol/L in LDL cholesterol has been found in homeless men after 12 weeks of training, indicating that the blood profile can also be improved in groups of people facing social and health challenges (12). In the latter study, the decrease in LDL cholesterol was greatest in those who started off with clinically high LDL cholesterol levels.

In 2010, it was also shown that 12 weeks of football training lowered serum total cholesterol by 5% in normally active men with moderate hypertension (13). Additionally, one study showed that middle-aged women with mild hypertension achieved a 0.4 mmol/L decrease in total cholesterol after 15 weeks of football training involving three 1-hour sessions per week (14). The same women continued to train twice a week; and after a year, both total and LDL cholesterol had increased more in the inactive control group than in the football group (15). These women continued to play football as they wished after the study.

A follow-up study 9 years after the initial intervention showed that the women – who had now entered menopause – had a significantly healthier blood lipid profile compared to the original control groups of women (16). For instance, total and LDL cholesterol decreased by 0.5 and 0.2 mmol/L, respectively, in the football group despite the fact that the women were menopausal, which is usually accompanied by an increase in blood lipids. In the inactive control group, these values increased by 0.7 and 0.4 mmol/L, emphasising that football training is an effective preventive strategy and potential treatment for age-related changes in cholesterol levels in both pre- and post-menopausal women.

In other patient groups, such as women aged 48-68 years and men with type 2 diabetes (17), a decrease of as much as 0.4 and 0.6 mmol/L in LDL cholesterol and total cholesterol, respectively, and a decrease of 0.4 mmol/L in triglycerides have been shown after 12 weeks of combined football training and a calorie-reduced diet. Similar findings have been demonstrated in older women and men with prediabetes (18), where positive effects on lipid profile were also found when football training and dietary guidance were combined for 16 weeks. The decrease in LDL cholesterol was observed in both women and men with prediabetes (19).

Together, these studies show that 12-16 weeks of football training combined with a calorie-reduced diet appears to lead to significantly greater improvements than diet alone.

That said, some studies find no significant decrease in plasma LDL and total cholesterol after football training (20). It is important to note that the training frequency in these studies was as low as 1.1 sessions per week, which may explain the neutral findings. It is reasonable to assume that 2-3 training sessions per week are needed in order to achieve a decrease in plasma cholesterol over 2-3 months. However, the long-term effects of low-frequency training are unknown as yet.

Another important element is the baseline level of blood lipids before starting exercise. One example of this correlation is a study by Randers et al. (12), which showed positive effects on cholesterol for participants who started off with the highest lipid values, but not for participants who started off with cholesterol levels within the normal range. As some of the participants in several of the studies conducted were also taking statins (cholesterol-lowering medication) and it is possible that these individuals would not respond as strongly to football training as people not taking cholesterol-lowering medication.

Conclusion and final remarks

An averagely small but clinically relevant and beneficial effect of football training on blood lipid profile has been documented. It seems that the greatest effects occur in people who who train frequently (at least 2-3 times one hour a week) and that football training has a positive and additive effect on cholesterol levels when combined with dietary changes (calorie-reduced diet), and the effect is most pronounced in participants who have the highest cholesterol levels when exercise begins.

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FOOTBALL FITNESS REACHES ALL THE WAY TO THE FAROE ISLANDS

High cholesterol can present a challenge to many, but in the Faroe Islands, football has been found to be the solution.

For many people in football-loving Denmark and across the country's municipalities, 'Football Fitness' has become an important part of leisure time as a way of improving health and building a sense of community.

And the concept has actually reached all the way across the Danish Realm. In fact, it was embraced there a while ago. 'Football Fitness' has been running in the Faroe Islands for nine years. This is a class for women who are primarily post-menopausal.

High blood pressure and high cholesterol are some of the challenges that could potentially be faced by women on the team, but that's all changed thanks to 'Football Fitness' training.

One of the women who is involved since the very start and still turns up every time is Sólrun Gledisheygg.

"It's interesting to meet so many women from different backgrounds who are dealing with so many different things in their lives," says Sólrund Gledisheygg.

They train at the club three times a week: on Tuesday and Thursday nights and Saturday mornings. That is more exercise than most. Attendance is not compulsory, and there are no tournaments at stake. It is all about getting their heart rates up, enjoying a good workout and having a good time with their teammates.

"That sense of community is really important now that we're not as young as we were. We've all significantly expanded our social networks, and several new groups of friends have emerged. On the pitch, we're all the same and nobody needs to even know what we all do for a living, or what background we all come from. We've only caught onto that over time."

Research into effect

'Football Fitness' in the Faroe Islands has appeared in the media in Denmark over the years, because it's a great example of how physical challenges such as high cholesterol can be overcome with football.
And that's also something they talk about on Sólrund Gledisgeygg's football team, she says.

"Football keeps us physically active. We're in better shape, and we're more mobile. People who've had high blood pressure found that their blood pressure dropped, for instance. We also find that our balance is better, and there's always a good atmosphere here," says Sólrun Gledisheygg.

"We get plenty of fresh air, which is good for our health. A lot of research has been done into 'Football Fitness' in the Faroe Islands, and we get up close and personal with the researchers because the islands aren't all that big up here. That's why we pay a lot of attention to what research has shown about the beneficial effects of football. Especially for ladies our age," she says.

Travelling together
Last year, 22 women aged 46-69 travelled to Iceland, where they met with the Football Association of Iceland to talk about their 'Football Fitness' team and explain how football has helped them.

And this is a very special football team. Because while most people might prefer to stay indoors in the warm in winter, Sólrun Gledisheygg and her teammates can be found outdoors, on the football pitch.

"Of course, in winter the weather is a bit nasty sometimes and not ideal for playing football, but we take that as a challenge. The municipality offered us an opportunity to train indoors instead, but we turned it down. We'd rather train outdoors. Knowing that football has these beneficial effects motivates us, but the sense of community we get is probably what keeps us going."

8. BREAST CANCER

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Introduction

Breast cancer is one of the most common cancers among women in Denmark (1). However, improvements in the treatment of the disease mean that it is also one of the cancers with the highest survival rates. The primary treatment is surgery; and depending on the extent of the disease, surgery is combined with chemotherapy, antihormonal therapy and radiotherapy before and/or after surgery (1). Treatment can cause late effects including fatigue, weight gain, sexual problems, joint pain, chronic nerve damage, increased risk of osteoporosis, reduced function in the arms and shoulders and chronic arm swelling (lymphoedema) on the side where surgery was performed (2,3). These late effects can impair the woman's health-related quality of life and, in the long term, increase the risk of cardiovascular disease and new cancers (4).

The latest guidelines for physical activity in people being treated for cancer state that physical activity and structured and supervised exercise are beneficial and safe (5).

Research suggests that both aerobic exercise and strength training or a combination of both 2-3 times a week for a period of 8-12 weeks has positive effects on fatigue, physical function and health-related quality of life (6). Additionally, studies suggest that physical activity reduces the risk of disease recurrence and death after breast cancer (7). Since late effects are long-lasting, it is important to ensure that exercise is maintained over a long period of time (months and years) to sustain the positive effects, including the prevention of muscle mass loss and cardiorespiratory fitness. As osteoporosis is also a potential late effect, studies have also examined the impact of exercise on strengthening of bones (8). Here, the evidence is not conclusive. Thus, only studies that combine intense strength training with high-impact exercise (such as jumping) appear to significantly affect bone tissue. Consequently, more studies that investigate interventions targeting bone health have been warranted (9). Team-based interventions have been shown to have positive effects on both motivation and retention of new exercise habits (10). Given this knowledge base, several studies have investigated the impact of football as exercise in various patient groups and found positive effects on a wide range of mental and physical parameters, including bone health (11).

Football as health promotion and rehabilitation in women treated for early breast cancer

The Football Fitness After Breast Cancer (ABC) project was launched in 2016 (12). The aim of the project was to determine whether twelve months of football training would affect muscle mass, bones, balance, fitness and quality of life in women treated for early breast cancer. As there has previously been concern that intense physical activity with unpredictable elements, as seen in team sports, could increase the risk of lymphoedema, the project also wanted to investigate whether participation in football training was related to a higher incidence of lymphoedema compared to the control group.

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Training took place on outdoor pitches twice a week from March to November, then indoors from November to March. The training consisted of a 15-minute warm-up following the 11+ principles (13), 15 minutes of technical exercises and 3-4 drills or small-sided games of a duration of 7 minutes, with a 3-minute break in-between. Games were played on small pitches, with 4-6 players on each team (12). The women in the training group participated in just under half of the possible training sessions, and the intensity during the part of the training where matches were played was at least 80% of maximum heart rate for 70% of the time (12).

The study found that participants in the football group had improved their muscle strength and balance, as well as their bone strength. Additionally, a reduction in participants' physical limitations was reported after 6 months. The positive impact on bone health constitutes an important finding, as bone health is a significant focus area for the target group (14).

The exercise did not lead to improvements in fitness, which may seem surprising. One possible explanation for this could be that, on average, the participants trained just once a week, which may maintain fitness but is often insufficient if the goal is to improve overall fitness. Conversely, the study suggests that this is sufficient if the objective is to improve bone health.

After the study ended, some of the participants chose to contact a local football club to continue training there. Working together, they created a special Football Fitness ABC team that was open to other women who had previously been treated for breast cancer. An interview study among these women showed that they felt part of a meaningful and supportive community when they continued training on their own. In this way, football became a part of their identity, and they found that it led to a healthy lifestyle choice (15).

Since then, the team has established contact with both municipal training centres and hospitals with the aim of establishing a collaboration to ensure that other women treated for breast cancer are also given the opportunity to participate. In this regard, they have expanded the eligibility criteria to include all women who have undergone treatment for cancer.

In terms of safety, 21 sports injuries were recorded across 15 participants in the football group, including ankle sprains and muscle strains, which resulted in an average of 2 weeks' absence from training. In the control group, 3 injuries were reported in 2 participants (16). Specifically, there was no difference between the football group and the control group in terms of lymphoedema and self-reported arm and shoulder function (17).

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Conclusion and final remarks

Overall, the Football Fitness ABC study suggests that women who have had breast cancer can participate in football with no particular risk of lymphoedema or serious injury, and the exercise appears to improve bone health, muscle strength and balance.

Other concepts such as Football Fitness, Football for the Heart and FC Prostate, where courses have been developed for future coaches, may be useful (18). FC Prostate has learned that close cooperation between the hospital or municipality and the local club is of major importance for the continued intake of players. The coaches have also expressed that the formal training has had a positive impact on their approach to coaching. Any concerns about being responsible for training a group of people who have been treated for a serious illness vanish once the actual football training has started and the group builds up its own culture (19).

The initiative offers potential for further expansion, which requires the development of training manuals. Additionally, establishing collaboration agreements between public entities, patient associations, and football clubs would be beneficial.

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REGAINING CONTROL OF YOUR BODY ON THE PITCH

After an intense cancer journey, football is helping Anna Ross Agner to find herself and a community where everyone has a scar and a tale to tell.

Like most footballers, 49-year-old Anna Ross Agner meets up with her teammates every week to train. And just like any other football team, they practice feints, kicking and various kinds of dribbling with the ball.

And yet their team is not like everyone else's. Because Anna Ross Agner has had breast cancer, and so have the other team members.

This creates a special sense of community among her teammates that Anna Ross Agner has never encountered anywhere else.

"It's just really great to come and share things that others can't really relate to. It's only natural for me to want to show someone my scar and tell my story, and vice versa," says Anna Ross Agner.

Rediscovering control

It is almost a decade since Anna discovered a lump in her breast. Just a few days later, she was under the knife and about to have it removed. But although everything went according to plan and she was declared cancer-free shortly after the operation, the process had a major impact on her.

"It was absolutely awful. You relinquish control and let others make decisions about your body and just go with the flow," she says.

Exercise was not a big part of Anna Ross Agner's life before her cancer diagnosis. But this changed after her surgery, when she was offered a rehabilitation programme through the hospital that focused on exercise.

At the hospital was also where she later found out about the opportunity to join a project that involved playing football with other breast cancer patients. The team was called 'Football Fitness ABC', which stands for 'After Breast Cancer', and was being monitored by a research team from the University of Southern Denmark and the University of Copenhagen.

Her active life ended up making a big difference.

"For me, it meant I could take control of my own body again. I learned that I could keep myself up even when I was pushed down," she says.

Better on the pitch
Today, she continues to play football with a number of players from the project. Anyone can join the team regardless of level. Nevertheless, Anna Ross Agner now enjoys feeling how she gets better every time she steps out oton the pitch.

"That feeling of 'I was really good today' can really improve your quality of life," she says.

She has just undergone surgery that has kept her off the football pitch for three months.

But she was right back on the pitch just as soon as her body allowed her to play football again.

"The training and the team spirit really cheer me up. It's nice to feel like my body is capable of doing this, even though I might be a bit rusty after taking a break like this. I'm sure it'll all come back to me."

9. PROSTATE CANCER

Jacob Uth[1], Klaus Brasso[2,4], Julie Midtgaard[3,4], Peter Krustrup[5]
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Introduction

Prostate cancer is the most common cancer among men in Denmark, with about 4,500 new cases and about 1,300 disease-related deaths annually. The causes of the disease are partially unknown, but age, lifestyle, and heredity are significant factors. Overall, the chances of living a long life with prostate cancer are good, and over 30,000 Danish men are currently living with the disease (1).

Early-stage prostate cancer can be treated curatively with either surgery or radiotherapy, or observed without treatment. Advanced disease that has spread will be treated with hormone therapy in most cases to slow down tumour growth, possibly supplemented with chemotherapy. The choice of treatment depends on the stage of the disease, patient age, health condition and individual preferences (1). Treatment for advanced disease includes hormone therapy, which for most patients usually involves medical castration. While this treatment is effective, it can lead to side effects such as impotence and sexual dysfunction, as well as an increased risk of developing diabetes, cardiovascular disease, and osteoporosis (1).

Regardless of age and disease characteristics, many men will find themselves in a situation where treatment will inevitably affect their quality of life. A systematic literature review examined the effects of cardio and strength training on quality of life and metabolic health in men with prostate cancer. Exercise was shown to improve cardiovascular fitness, leg muscle strength and mental health and reduce blood pressure and body fat mass (2), and therefore regular exercise is recommended (3). Other studies have shown that men undergoing cancer treatment are less likely than women to seek out established community-based training programmes (4) and are generally less physically active (5).

Football for health promotion and rehabilitation in men diagnosed with prostate cancer

Two randomised Danish trials (FC Prostate and FC Prostate Community) have been conducted to investigate whether football training for men with prostate cancer is safe and feasible, and whether participants gain health benefits compared to those receiving regular care (6,7). The first study investigated whether the intervention was feasible and had an impact on muscle and bone mass and physical capacity in men undergoing hormone therapy. This study was followed by a larger study (6), which aimed to examine whether the intervention could be implemented at local football clubs in collaboration with the local hospital, and how the activity affected quality of life and hospitalisation rates.

Training in the FC Prostate study involved a 15-minute warm-up followed by 2 x 15 minutes of match play (5v5 or 6v6 on small pitches). After 4 weeks, the training intensity and duration was increased so that matches were played for 3 x 15 minutes after the warm-up. Training took place 2-3 times throughout the 32 weeks of the study (7). In

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the FC Prostate Community study, the training was organised so that the warm-up, technical exercises and match elements each lasted 20 minutes (6). Participants were offered training at a local football club twice a week for 6 months. After this period, participants could choose to join the club and continue training on the same terms as other members, which the majority did (8).

In the FC Prostate study, the results showed that participants' average heart rate was 84.6% of the maximum heart rate, and the heart rate was above 90% of the maximum heart rate for 26.8% of the training time. In this context, training time is understood as the part of training that is organised as match time (9). Additionally, participants performed almost 200 accelerations and almost 300 decelerations during a training session in which they played a 3 x 15-minute match. They ran 2645 m, 905 m of which were covered at speeds of at least 6 km/h (10).

After 12 weeks, this training led to a 0.7 kg increase in muscle mass and a 14% increase in leg muscle strength. There were also improvements in fast stair climbing and jump height tests (9). This reflects the ability to quickly develop muscle strength, which is essential for fall prevention. Furthermore, scans showed that training had increased bone density in the femur after 32 weeks, which is a significant finding as hormone therapy leads to bone mass loss (9,11). The study also showed a correlation between the number of intense decelerations during football training and the effect on bone mass (12). The trial ended after 32 weeks as planned, after which time participants in both the intervention group and the control group were offered the opportunity to continue training at a local football club. After 5 years, the participants were invited for further tests; and it was found that those who had carried on with football training had improved femur bone mass compared to those did not play football, which supports the assumption that football training has a bone-stimulating effect in men undergoing treatment for prostate cancer (12).

Similarly, the FC Prostate Community study found that after 1 year, training had improved femur bone mass and that participants in the football group had 40% fewer hospitalisations compared to the control group. The men who had participated in training at least once a week also improved their mental health and reduced their fat mass by 0.9 kg compared to the control group (13). Additionally, participants saw football as an opportunity to regain control and take responsibility for their own health. Furthermore, football training legitimised and enabled the exchange of care and recognition in a way that, within the context of football, protected the men from loss of masculinity (14).

A survey of the partners of the participating men supports these findings, with partners indicating that their husbands had become more active and had more energy for other activities after they started football training, and that this helped to recreate marital well-being (15).

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Five injuries were recorded in the FC Prostate study. Of these, the two most significant injuries were a fractured fibula and a partial rupture of the Achilles tendon. In the FC Prostate Community study, 58 minor sports injuries and one partial and one complete rupture of the Achilles tendon were recorded from 0-6 months. These injuries are considered to be expected in relation to sports participation and should be viewed in relation to the significant health effects that were detected. This includes a lower incidence of hospitalisation. A study focused on uncovering the men's experience in relation to injury risk was conducted. The overall opinion was that exercise-related injuries were an acceptable – and for some even psychologically attractive – consequence of taking part in football (16).

Conclusion and final remarks

Current evidence shows that football as a training programme for men with prostate cancer has positive effects on physical fitness, body composition and mental health, while men find that football allows them to take care of themselves and their teammates without feeling like patients.

FC Prostate is currently offered at 20 football clubs all over Denmark. The close collaboration that has existed from the outset between medical staff at the hospitals, researchers, the Danish Football Association and the local football clubs and trainers who organised the training are all crucial elements in this. Establishment of a training programme for trainers, which has given clubs a solid professional foundation when starting new teams, has been an important tool in this process (17). A recent study also shows that coaches appreciate having completed formal training before starting their FC Prostate teams, and say that leading the training of a clinical population is meaningful and easier than they expected (18).

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"I JUST COULDN'T LIVE WITHOUT IT"

'FC Prostate' makes a difference to both body and mind. John Lindskou Holdt is excellent proof of this. He's played for 'FC Prostate' for more than a decade and has no plans to call a halt to his football career.

Being 85 years of age is certainly no obstacle for John Lindskou Holdt. Every Monday and Thursday, he drives from his home at Sjællands Odde to his training session at BK Frem in Valby to play football and chat in the café with the other players from 'FC Prostate'.

John Lindskou Holdt was diagnosed with prostate cancer in 2011 and has been involved from the very start when 'FC Prostate' began in 2012.

"I just couldn't live without it. If I haven't been to football, I notice it straight away. When I move, I feel much better and I'm happier."

'FC Prostate' is a recreational football programme for men with prostate cancer and aims to help them create a path back to life after cancer. This unique offering is currently available at 20 clubs all over Denmark.

Players on the 'FC Prostate' team in BK Frem are between 63 and 85 years of age and their level varies. Some of them have never touched a ball, some have not played since they were kids at school, and others are more experienced. But that really does not matter. John Lindskou Holdt sums it up perfectly.

"We don't all play equally well, but we all do our best."

Oldest member and team leader

When John Lindskou Holdt and the other players have been dribbling, high-fiving and trying to score goals for about an hour, with a few breaks along the way, they all head off to the café for a drink and a bite to eat. The ageing footballer explains that the social element is really important.

"We chat about all kinds of things. Not just about disease and treatment, but about the whole world. We all have one another, and we're all friends."

Besides being the oldest member of the team, John Lindskou Holdt is also the team leader. He is responsible for coordinating things if the 'FC Prostate' players have to play against other teams and makes sure they can all get a sandwich or a drink after football training.

"It matters a lot to me. Maybe I get a bit too involved, but I love helping others."

John Lindskou Holdt is now cancer-free and only sees his GP once a year.

'FC Prostate'

'FC Prostate' has been running since 2012, and in 2016 received 'Danskernes Idrætspris' (the Danish Sports Award) for being "a pioneering collaboration between research institutions, club sports, hospitals and patient associations".

Today, 'FC Prostate' teams can be found all over Denmark, and this large number of teams is also due to an active ambassador association, which organises an annual event. New teams are still being added, typically emerging out of the welfare alliances forged by the Danish Football Association with municipalities all over Denmark.

The project is supported by Trygfonden and the University Hospitals Centre for Health Research (UCSF), the University of Southern Denmark, the University of Copenhagen and the Committee for Health Information have been key partners along the way.

If you would like to know more about 'FC Prostate', more information is available on the Danish Football Association website. You can also find out more here about the 'FC Prostate' coaching course.

10. MENTAL HEALTH ISSUES

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Introduction

Mental health problems are characterised by mental and emotional discomfort and can be experienced as sadness, low life satisfaction, stress, anxiety or a sense of unease. Mental health problems range from non-clinical symptoms of the above, to clinically diagnosed mental disorders characterised by more severe and persistent symptoms that significantly affect daily functioning and quality of life.

The perception of mental health problems also has an overall adverse impact on the individual's thoughts, feelings, behaviour and quality of life. For instance, sufferers may become more socially withdrawn, become less motivated to do new activities or activities they have previously enjoyed, have poor sleep and experience a lack of or increase in appetite. This often makes it difficult for the individual to feel happy and function on a daily basis.

Mental health problems are on the rise in the Danish population (people aged 16-64). The Danish Health Profile (2021) (1) showed that 17.4% of people aged 16-64 rated their mental health as low compared to 10% in 2010; and while mental health problems affect all population groups, there are specific population groups that are hardest hit, such as socially vulnerable people, people with chronic illnesses and young people (people aged 16-24).

Football to prevent mental health problems

Football is a popular sport all over the world that can reach groups in society that may otherwise be difficult to engage, such as the socially vulnerable (2). As such groups often include a higher proportion of people with mental health problems, football can provide a suitable context for activities aimed at preventing distress. Additionally, physical activity has a strong preventive effect on mental health problems, such as depression, anxiety and stress (3). That said, the improvement in physical health that results from participating in football also plays an important part in preventing mental health problems.

Football has the added benefit of being a social activity that can strengthen a sense of belonging, which in itself can increase wellbeing and prevent depression, anxiety and other forms of mental health problems (4). However, despite its clear potential, it is important to emphasise that there is a lack of research evidence into football specifically as a primary way of preventing mental health problems, which limits our understanding of the factors involved in the use of football as prevention. Moreover, in addition to primary prevention – which aims to prevent mental health problems from occurring – it is also important to consider whether football can act as secondary prevention. This involves preventing mental health problems from developing.

The 'It's a Goal' football programme from the UK aimed to improve mental wellbeing and prevent the development of serious mental illness in adult men referred to the programme via the health service (5). This programme de-stigmatised mental illness by using words like "goals" instead of problems and "players" instead of psychiatric patients, and delivered

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the programme in football stadiums and not in clinical environments. Participants explored personal challenges and built confidence and motivation over eleven sessions designed as a football formation. The programme had a positive impact on participants' wellbeing, which can help to prevent serious mental illness. For instance, football clubs can play a part in preventing mental health problems by providing resources (such as stadiums and, possibly, trainers) and organising teams and activities that target populations with or without mental health problems.

Football as therapy for mental health problems

In recent years, greater attention has been paid to programmes that use physical activity and sport as complementary therapy or treatment for mental health problems. Football-based initiatives are particularly popular in the UK, especially among men. These initiatives often aim to improve overall quality of life by addressing various challenges such as social exclusion, stigma and physical health and increasing the sense of empowerment that has the potential to make a difference for this group of people. As such, they do not focus specifically on treating mental health problems.

A literature review conducted in 2017 suggests that there are positive benefits of using football as a complementary therapy or treatment, especially for men (6). According to participants, participation in football resulted in feelings of lower self-stigmatisation and less social isolation while also alleviating symptoms and improving participants' physical health. Additionally, the programme enhanced positive experiences of belonging, improved self-confidence, increased well-being and gave participants' lives structure and purpose (7).

There is still a lack of studies using a research design that can demonstrate cause and effect (e.g. so-called randomised, controlled trials with intervention and control groups), which is why it is not possible at present to definitively conclude that football is effective as a treatment for mental health problems. However, due to research into physical activity and sport in general it can be surmised that football may have an impact. For instance, a meta-analysis summarising quantitative research evidence has shown that physical activity is effective in treating depression and anxiety in non-clinical groups (9).

Other literature reviews have shown that participation in sports in middle-aged and older people is associated with reduced depression, anxiety and stress (10), improved wellbeing and a strengthened sense of social wellbeing (11), which in itself can help to treat ill-being. Hence there are good reasons to offer football as a form of treatment for mental health problems. It is important in this regard to highlight the fact that football programmes appear to be feasible and appreciated by participants. This is particularly true for young men, who are otherwise characterised a hard-to-reach group.

Conclusion and final remarks

Mental health problems are widespread and on the increase among the Danish population, especially among certain population groups. That is why it is important to prioritise the identification of cost-effective initiatives that can prevent and treat mental health problems. Football has clear potential to prevent and treat mental health problems. Firstly, increased physical activity, improved health and a sense of belonging with other people can prevent and reduce mental health problems. Secondly, this is an activity that attracts people who are otherwise difficult to engage in health promotion initiatives. Finally, the football programmes seem to be feasible and appreciated by participants. At the same time, research shows that football has favourable conditions for retention (12). However, a lack of studies that can prove cause and effect means that there is a lack of research evidence to definitively conclude that football is effective in these respects.

The development of football programmes aimed at preventing or treating mental health problems should focus on de-stigmatising mental health problems and optimising the sense of belonging. It is also important for these programmes to make use of behavioural science and motivation theories in order to maintain behavioural change (13). Additionally, it may be useful to deliver the programmes at professional football clubs in order to optimise participant engagement, as has been the case with other health promotion programmes (14).

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WHEN FOOTBALL IS A VITAL PART OF LIFE

For some people, football is so much more than just a sport. Marie is one of them.

Marie's life is much the same as the lives of many other 37-year-olds. She is a mother of two children, married and is a trained teacher. And she plays football. But football is more than just a leisure activity for Marie, who has been diagnosed with bipolar disorder.

"I take medication and that stabilises me, but what really keeps me going is the exercise, the football and the community. All the things it triggers inside me."

Marie plays football three times a week on average, and she says she would play even more if she could. She is part of OMBOLD, a football community for people in vulnerable positions, which has room for everyone regardless of gender, age and football skills. And for Marie, training at OMBOLD is a must-have part of her life.

"It's become kind of like a football family, where you have a safe space and support each other and know that people have their tough days. But that doesn't have to be the focal point," explains Marie.

A dream come true

Football has always been a big part of Marie's life. As a child, she looked up to her older brother who played football, so of course the girl from Birkerød with the big mass of curly hair should do the same. Playing football has been an active part of Marie's life ever since, but it is also helped shape the person she is today.

"It's amazing to be where I am today. I never thought I'd have a husband and children and education and practical experience. It's crazy to think that everything I always hoped for but didn't believe was possible is actually happening and has happened."

Marie was previously part of Hjemløselandsholdet (the Homeless National Team), where players have to have either been affected by homelessness or been undergoing treatment for substance abuse within the past two years, or like Marie, that they are struggling with mental illness.

New collaboration: Inclusion in Football Denmark

OMBOLD and the Danish Football Association are collaborating on the 'Inclusion in Football Denmark' project.

The aim of this is to encourage activity among people such as the homeless, the mentally vulnerable and addicts in communities at football clubs all over Denmark. Working in close collaboration with the local municipality and local football clubs, the project aims to create a safe environment for the target group so that they can connect with local sports environments. A coaching course has been developed in this regard that is aimed at current and future trainers of football teams for socially disadvantaged and mentally vulnerable people.

This work is being supported by Nordea-fonden.


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FUTURE RESEARCH PERSPECTIVES

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In 2018, the Danish Health Authority published a White Paper on "Fysisk træning som behandling. – 31 lidelser og risikotilstande" (Physical exercise as treatment – 31 disorders and risk conditions) (1). The publication described the evidence base for physical exercise to prevent or actually treat 31 different disorders and diseases, syndromic diagnoses or risk conditions. This White Paper provides an overview of the available evidence on the use of football training for ten disorders and risk conditions. The material covers more than 15 years of research efforts mapping aspects that characterise football training as a form of exercise for untrained people and lightly trained participants of all ages, and how football training can be used as a tool to prevent and treat lifestyle-related risk conditions, disorders and diseases.

Research into football as a way of promoting health has been quite extensive in Denmark over the past 15 years, and also in a large number of other countries on several continents over the past 5-10 years. The available research provides plenty of insight into the use of football training as prevention and treatment – or part of the treatment of the 31 disorders and risk conditions that physical activity can be used to treat, according to the Danish Health Authority. However, there are also many areas where evidence is still lacking; as outlined below.

Much of the evidence concerns the effects of football training in short and medium-term interventions, which is why it is desirable to continue the work and assess the long-term effects of football training in cases of cardiovascular disease, type 2 diabetes, osteopenia and certain cancers, for instance, where initial long-term studies suggest a significant effect. There is also a need to conduct actual trials on how effective football training is in direct comparison with tablet medication or as a combination treatment with tablet medication. Such trials are already in progress, as exemplified by the RapaLoad project, which is a randomised trial being conducted at Odense University Hospital and the University of Southern Denmark with 4 trial groups involving a total of 136 women aged 45-60 years. The RapaLoad project compares bone medication with the effects of football training. The effects of combination therapy are also being investigated.

Similarly, it would be interesting to expand the research into the use of football training to cover other disorders and risk conditions, such as (in alphabetical order) Anxiety, Asthma, Chronic Obstructive Pulmonary Disease (COPD), Dementia, Depression, Infections and Parkinson's Disease, all of which are included in the Danish Health Authority's list (1).

Initiatives are already in progress that are trialling football training for target groups with Parkinson's syndrome ('FC Parkinson') and Dementia ('FC Dementia'), as well as long-term unemployed young people on public benefits ('Football for the Future'), and the 'En del af holdet' (Part of the team) project, which includes children and young people with disabilities, diagnoses and other special needs. One thing these projects have in common is the need for actual research evidence behind them. This is why follow-up research and further studies in relation to these are recommended.

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Last but not least, it will be interesting to examine how to persuade even more people to promote their health by means of football training, and whether some of the new versions of football training promoting recruitment and implementation also have a major impact. Walking Football has gained in popularity in Canada, the UK, Sweden and Southern Europe in the last five years; partly for the target group of older people, and partly as projects aimed at groups of patients suffering from type 2 diabetes and prostate cancer, for instance. Walking Football has been described in research as 'feasible' with good exercise feasibility, relatively few injuries, high recruitment potential and a higher physical load than regular walking (2,3). However, there is still a significant need to examine just how effective this type of football training is in relation to the ten disorders and risk conditions described in this White Paper, and also in relation to other disorders and risk conditions where physical activity has been shown to be effective, as outlined in the Danish Health Authority's publication.

References

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"WE CAN ALL HAVE A LAUGH WITH EACH OTHER ON THE PITCH"

Everyone makes mistakes at FC Dementia, and that's absolutely fine. Here, team spirit is more important than ability on the pitch.

The first signs happened at work. Because when 54-year-old firefighter Jesper Søgaard Nielsen was given orders, he quickly forgot them again, and his memory wasn't what it used to be when he was under pressure.

At home, it was taking him longer to cook meals, and he frequently left his phone in places where he couldn't find it again.

Both colleagues and family members advised Jesper Søgaard Nielsen to see a doctor, and after a lengthy examination, the diagnosis was clear.

Jesper was one of the 85-90,000 or so people in Denmark to be affected by dementia.

Never played football before

Not long after Jesper was diagnosed, a dementia consultant from the municipality introduced him to the FC Dementia football team.

He had always led an active life, but this was his first foray into football. So with more than a little scepticism, he pulled on his football boots.

But that scepticism quickly turned to excitement when he realised it wasn not all about being the best at kicking a ball.

Instead, there was room for everyone and all the mistakes people can make when their memories fail.

"My sense of place isn't always what it used to be, and people do as much running off the pitch as they do on it. But we just laugh about it, because in this team we laugh not at each other, but with each other," says Jesper Søgaard Nielsen.

Community is very important
Community is extremely important to Jesper – that's what keeps him coming back week after week.

The team trains once a week. And the team takes care of its players even when the disease is really affecting them.

"Until recently, we had a player who was very poor at the end. But relatives are welcome on the team as well, so his wife came along to the training sessions and ran around with him, holding his hand so that he could still play," says Jesper.

After training, players often sit and share their situations with one another.

"We don't just talk about our illness. But it's always nice to share stories with others in the same situation and find out that they experience the same things I do. It creates a very special sense of camaraderie," says Jesper Søgaard Nielsen.

That is why he is confident he will go on playing football for as long as his mind and body allow.

"I look forward to football every week. I've got a lot out of it," says Jesper Søgaard Nielsen.

FC Dementia
FC Dementia provides recreational football for people with early-stage dementia or dementia-like symptoms.

The objective is to mitigate and alleviate the negative effects of development of the disease. Creating and offering tailored football programmes provides participants with the opportunity to improve their physical activity levels and be included and retained in association sports, one of society's strong communities. This reinforces participants' sense of identity, quality of life, active citizenship and overall health, which may otherwise be challenged as a result of dementia.

FC Dementia is supported by the Danish Football Association, TrygFonden, Sygeforsikringen "danmark", the Danish National Board of Social Services and Alzheimerforeningen.

If you would like to know more about 'FC Dementia', more information is available on the Danish Football Association website. You can also find out more here about the 'FC Dementia' coaching course.


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