Original Article

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Football beats hypertension: results of the 3F (Fit&Fun with Football) study

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Objective(s): Football as the most popular sport could improve insufficient physical activity in patients with cardiovascular risk factors. A modified 'healthy' football training format could motivate hypertensive patients to return to sport and improve risk factors.

Methods: The 3F study: 'Fit and Fun with Football' a prospective interventional study with 1 year follow-up. Football group: $n = 103$, structured 'health'-football training (1×/week, 90 min) led by Deutscher Fußball Bund-licensed football coaches. Hypertensive patients at least 45 years who have not exercised for several years were compared with a control group ($n = 105$).

Primary study objective: Reduction of office (OBP) and/or 24-h ambulatory blood pressure (BP) monitoring (ABPM) and/or reduction of number or dosage of antihypertensive medication.

Main results: OBP values decreased significantly in the football group from 142.6/87.9 to 130.8/81.8 mmHg ($P < 0.001$), in the control group the values increased slightly (NS). ABPM values decreased significantly in the football group, while a slight increase was found in the control group. At the end of the study, the mean values in the football group of both OPB ($P < 0.001$) and ABPM (systolic $P < 0.001$, diastolic $P = 0.017$) were significantly lower than in the control group. Significantly more people in the football group were able to reduce antihypertensive patients than in the control group (football group:16, control group:6), while more participants in the control group intensified antihypertensive therapy (football group:3, control group:14) ($P < 0.001$). Among the secondary endpoints, there was a weight loss of 3 kg in the football group and an increase of 1.7 kg in the control group ($P < 0.001$).

Conclusion: Offering modified 'healthy' football-training to middle-aged hypertensive patients can lead to better BP control and a reduction of antihypertensive medication. Therefore, the offer of 'health football' should be established and supported by clubs, insurances and authorities.

Keywords: 3F-study, ABPM, arterial hypertension, cardiovascular risk factors, fit-and-fun-with football, soccer

Abbreviations: 3F-study, Fit and Fun with Football-study; ABPM, 24-h ambulatory blood pressure monitoring; BP, blood pressure; CVRF, cardiovascular risk factors; DFB, Deutscher Fußball Bund (German for: German Football Association); ELITE, Ernährung, Lebensstil und individuelle Information zur Verhinderung von Herzinfarkt, Schlaganfall und Demenz German for: Nutrition, Lifestyle and Individual Information for the Prevention of Heart Attack, Stroke and Dementia; HR, heart rate; OBP, office blood pressure

INTRODUCTION

The most important cardiovascular risk factors (CVRF), such as arterial hypertension (AH), hyperlipidaemia, diabetes mellitus, obesity, and psychological stress, can be effectively improved by performing regular physical activity [1,2]. Although the preventive benefits are well documented, more than half of the population in Western industrialized countries perform physical activity less than recommended [3–5]. Football is by far the most popular sport in Germany and Europe. Its great popularity could help motivate more people with CVRF to exercise. However, football currently has no significance as a prevention or health sport. In addition to the typical competition-oriented soccer, there are only a few offerings in Germany that focus exclusively on health aspects. This is especially true for older people with higher risk who have been inactive for a long time. A training format geared towards improving fitness and health without a significant risk of injury could motivate many people to return to playing sports. Football

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has already all the basic prerequisities to have a successful concept: nationwide infrastructure, the most popular sport in Germany with the largest number of members, and a large pool of trained coaches. However, the evidence showing that football successfully influences the CVRF is not considered sufficient. In particular, there is a lack of studies evaluating older patients with risk factors [6,7].

The aim of the '3F study: Fit and Fun with Football' was to prove the effective reduction of blood pressure (BP) in patients with hypertension who have been inactive in sports for many years, to evaluate a training concept geared towards health and the prevention of injuries, and to achieve sustainability through a training of coaches and long-term connection to football clubs.

METHODS

Study design

The 3F study was conducted as a prospective interventional study. The effects of structured football training led by licensed football coaches in people minimum aged 45 years with hypertension who have not exercised for several years were investigated and compared with a control group. The Institute for Clinical Research (INFO GmbH) at St. Josefs-Hospital in Cloppenburg (Germany) was responsible for the study management, design, collection, and evaluation of the data. The participating football clubs implemented the training programme, and the training was predetermined by the training plans of the head football coach. The protocol was approved by the ethics committee of Georg-August University Göttingen and registered in the German Register of Clinical Studies (DRKS00017635). The first, second and last authors drafted the manuscript, the third author was responsible for the statistical evaluation, all other authors participated in the improvements of the manuscript. The decision to submit the manuscript for publication was made jointly by all authors, who also guarantee the completeness and correctness of the data and the study conduct.

Recruiting, training, and implementation

The basis for recruitment was the ELITE study, in which data on CVRF, were prospectively collected including BP, laboratory values, dietary behaviour, physical activity, cognitive function, depression, wellbeing, psychological stress, and medication [3,4]. Everybody in the ELITE study received a detailed, written recommendation for cardiovascular prevention based on their individual risk profile. They were re-examined regularly every year or at least every second year. Computerised filtering of ELITE participants who met the following criteria was used to recruit participants for the 3F study: Men aged 45 years and older, with treated or untreated AH, who had not exercised regularly for years. A total of 327 men met these criteria and were randomly contacted by the study centre staff.

The objectives of the 3F study were explained to them, and they were invited to participate in a football training. In parallel, additional individuals from the same list were randomly recruited for the control group. All members of both groups were required to undergo a medical examination such as echocardiography, ergometry, and duplex examination of the brain-supplying arteries. Recruitment was conducted between 2018 and 2019. Participants of the control group were not informed that they were part of the control group to avoid bias.

All participants had already received a clear and detailed written recommendation to increase exercise in the ELITE study. Thus, the 3F study compared an intensified written prevention recommendation with an additional newly offered prevention measure, namely, playing football under guidance. Therefore, the control group was already much more intensively informed about the need for prevention measures, advised, and re-monitored than is usually the case in practice.

The football players were divided into five groups, each of which was trained at five clubs under the supervision of a 'Deutscher Fußball Bund' (DFB)-licensed trainer. A centralized training content once a week for 90 min was conducted. The participants received instructions to perform additional sports privately.

The training contents differed fundamentally from those of competition-oriented football training. Training forms were used to avoid the risk of injury. Physical contact was prohibited, as was any form of tackling in general. Ball winning and ball handling were only performed by running and passing, and long-distance shots were not allowed. The primary goal of all game forms was to allow everyone to have fun during the game, regardless of the individual football skills. Special emphasis was placed on promoting coordination when moving and playing with the ball. The ball used was not a typical football, but a special lightweight ball (Team Junior 350) from Adidas. Regular stretching and drinking breaks were provided between trainings. Each player was weighed before training. Activities during training and, if needed, during the week was documented by most participants using the Ignite Polar Watch which also allowed a control of heart rate (HR) during training. For safety a nurse was present on the training days. All clubs have defibrillators. Fortunately, no first aid measures were needed.

Study participants

The training in five clubs began between July and August 2019. A total of 103 people were recruited to participate in the football group, while 105 comprised the control group. Eight individuals only participated for a few weeks due to the following reasons: terms of time [professional or private reasons ($n = 2$)], participants' capabilities were not met ($n = 2$), injuries occurred ($n = 4$) during the first training sessions [(Achilles tendon rupture ($n = 2$), one of them during training, he already had occasional complaints before the start of the study; fibular head fracture ($n = 1$, during the first training session, cleats caught in the turf), torn meniscus ($n = 1$)]. Thus, 95 participants completed the training program. Six participants did not want to take part in the training again due to the coronavirus pandemic in March 2020; moreover, they did not complete the final examination and were thus not available for the evaluation. Another seven participants decided to discontinue the training after the corona lockdown, but these participants completed the final examinations (included in the evaluation with reduced follow-up). In total, 89 patients were evaluated, 82 of whom had complete follow-up time.

A total of 101 people were included in the control group. 86 persons completed the final examination after 1 year. Fifteen persons were not convinced to take the final examination, three persons had cancelled the offered appointments several times for professional reasons, one person was treated for lymphoma. For the rest, the main reason for cancelling the follow-up appointments was the renewed pandemic lockdown.

Parameters

Data were collected through interviews and examinations by trained teams (physician assistants, nurses, and physicians) as well as through standardized questionnaires filled out by the participants. Blood samples were obtained by healthcare professionals.

At baseline, BP measurements (Microlife 'WatchBP Office' device, oscillometric measurement; Microlife, Widnau, Switzerland) were taken on both sides after sitting quietly for 5 min in three conventional measurements with a 1-min pause between each measurement. A cuff was used to fit the arm circumference. The average value of the arm with higher measurements was included in the evaluation. In the football group, the participants' BP was measured on each training day. In addition, the participants were asked to document their BP daily for 1 week a month after sitting quietly for 5 min (Beurer BM 27 upper arm BP monitor). For ABPM SpaceLabs 90207 devices were used and performed according to guidelines. Measurements were taken every 15 min between 0600 and 2200 h (day measurement) and every 30 min between 2200 and 0600 h (night measurement). The participant was informed about behaviours during the measurement and a representative working day was chosen. All participants in the football group carried out two ambulatory BP monitoring (ABPM). In the control group, only three people did not carry out any ABPM.

Study objectives

The primary study objective was to significantly reduce the office BP (OBP) and/or the ABPM and/or to reduce the number or dosage of the antihypertensive medication after 1 year in the football group compared with the control group. The outcome criterion was defined as a reduction in SBP by at least 5 mmHg and/or in DBP by at least 2.5 mmHg after 1 year, a reduction in the self-measurement or ABPM by at least 5 or 2.5 mmHg after 1 year, and/or a reduction in the number (at least one) or dosage (at least reduction in the existing dose into half) of antihypertensive drugs after 1 year.

The secondary study objectives were improvement in other CVRF (diabetes mellitus, smoking, weight, lipid metabolism disorders, and occupational stress), change in cardiovascular medications, change in the results of the above survey questionnaires, reduction in the daytime and night-time BP, BP values, and HR in ABPM.

Limitations due to the coronavirus 2020 pandemic

The coronavirus pandemic presented a particular challenge, in which training had to be interrupted between mid-March and mid-May. Therefore, the training phase was initially extended until the end of October but had to be terminated again and thus permanently at the end of September due to the second lockdown. The total training period was 14 months.

Statistics

In the case-number estimate, a reduction in SBP of at least 5 mmHg within the football group compared with the control group was considered clinically relevant. A SD of 10 was assumed based on the results of the ELITE study. With a power of 90% and the usual 1st kind error of $\alpha = 0.05$, the required number of participants per group was 86. Considering the possible dropouts, 100 participants per group were recruited. Statistical analysis was performed using the software package IBM SPSS Statistics, version 26. First, descriptive statistics such as frequencies, mean with standard error, minimum, maximum, and SD (variance) were calculated based on the available data. The relationships between two categorical variables were examined using cross-tabulations, followed by the Pearson's chi-square test. To evaluate the repeated measurements of categorical variables, the McNemar's test was used. For metric variables, the Kolmogorov–Smirnov test was used to assess whether the data were normally distributed. As a rule, a normal distribution was present; hence, parametric tests were used in further analysis. *t*-Test for unconnected samples was used to compare two independent groups. For repeated measures between inclusion and completion of metric variables, the paired samples *t*-test was used. In exceptional cases, the nonparametric Mann–Whitney *U* test or Wilcoxon test were used. For all statistical tests, the usual significance level of $\alpha = 0.05$ was chosen. Thus, for tests that yielded a *P* value smaller than 0.05, the null hypothesis was rejected and the alternative hypothesis was accepted, that is, decided based on significance.

RESULTS

The baseline data of the participants are presented in Table 1. The groups showed no or minor differences. Table 1 shows that both groups included a large number of people with a significantly increased risk for cardiovascular and cerebrovascular diseases. 54 patients (60.7%) in the FB and 55 patients (64.0%) in the control group were treated with antihypertensive agents. In the FG, 72.2% received antihypertensive therapy using 1–2 drugs, and 27.8% required three or more drugs (CG 67.3% and 32.7%, respectively, NS). There were no significant differences in medication classes, with the treating physicians closely following the hypertension guidelines (Supplementary Material, Table 1, http://links.lww.com/HJH/B708). Statins were administered to significantly more people in the control group than in the FG at the end of the study ($P = 0.043$). Control group was slightly but significantly older. However, the BP values were not significantly different at baseline. An analysis of covariance also revealed no significant difference in BP at baseline. (ABPM: SBP $P = 0.210$, DBP $P = 0.947$). Thus, both groups had equal starting BP conditions at baseline. An influence of dropouts or a different level of education or school-leaving qualification on age could also be ruled out.

TABLE 1. Baseline data

	Football group	Control group	Sign.
Number (*n*)	89	86	
Age [mean (range)]	55.8 (45–70)	58.4 (45–70)	$P = 0.013$
	***n* (%)**	***n* (%)**	
Hypertension treated	54 (60.7)	55 (64.0)	NS
With 1 or 2 AH	39 (72.2)	37 (67.3)	NS
with 3 or more AH	15 (27.8)	18 (32.7)	NS
BMI mean (range)	29.3 (21.2–46)	29.1 (19.8–47.8)	NS
LDL increase[a]	68 (76.4)	61 (70.9)	NS
Diabetes mellitus	10 (11.2)	6 (7.0)	NS
Nicotine abuse	12 (13.5)	9 (10.5)	NS
Coronary heart disease	4 (4.5)	4 (4.7)	NS
Peripheral artery disease	3 (3.4)	1 (1.2)	NS
Atrial fibrillation	1 (1.1)	1 (1.2)	NS
Stroke	0	1 (1.2)	NS
Risk factors			
RF 1 and 2	49 (55.1)	56.0 (65.1)	NS
RF 3 and more	40 (44.9)	30.0 (34.9)	NS
ESC score			
10-year risk: <1%	15 (16.9)	8 (9.3)	NS
10-year risk: 1% to <5%	44 (49.4)	47 (54.7)	NS
10-year risk: 5% to <10%	22 (24.7)	22 (25.6)	NS
10-year risk: from 10%	8 (9)	9 (10.5)	NS

AH, antihypertensive; ESC, European Society of Cardiology.
[a]LDL > 130 mg/dl and/or statins in premedication.

Office blood pressure

In the football group, SBP decreased by 11.8 mmHg (from 142.6 to 130.8 mmHg). DBP also decreased significantly by 6.1 mmHg (from 87.9 to 81.8 mmHg) (both $P < 0.001$). HR decreased by 4.4 bpm ($P < 0.001$). In the control group, however, SBP increased by 2.1 mmHg, while the DBP increased by 0.4 mmHg (NS). When comparing the two groups, the BP values and frequency did not differ significantly before the start of the study. At the end of the study, these values were significantly lower than those in the control group. Thus, the difference between the groups at the end of the study were as follows: 12.3 mmHg for SBP and 6.4 mmHg for DBP (Fig. 1). The BP reduction in participants treated with antihypertensive medications did not differ from that of the untreated participants. There was a nonsignificant trend for an increase in SBP values in the control group ($P = 0.071$).

Figure 2 shows the course of BP values over time. In the first 3 months, the amount of BP reduction was still low and then the value continued to decrease (nearly 10 mmHg after 6 months of training).

Ambulatory blood pressure monitoring

At baseline, the ABPM values in the football group did not differ from those in the control group (Table 2). The BP values decreased significantly in the football group: SBP from 125.7 to 120.7 mmHg and DBP from 77.9 to 75.1 (both $P < 0.001$), but not in the control group. In the control group, the SBP increased from 126.4 to 128.46 mmHg ($P = 0.152$). The DBP slightly changed from 77.9 to 78.2 mmHg ($P = 0.756$).

At the end of the study, the ABPM values of the football group were significantly lower than those of the control group: SBP by 7.73 mmHg ($P < 0.001$) and DBP by 2.85 mmHg ($P = 0.017$).

Correspondingly, there were also differences in the changes in the daytime and night-time mean values (Table 2). At the beginning of the study, no significant difference was observed between the systolic ($P = 0.242$) and diastolic daytime mean values ($P = 0.847$) and systolic ($P = 0.570$) and diastolic night-time mean values ($P = 0.897$) between the two groups. At the end of the study, the daytime and night-time mean values of the football group decreased significantly compared with those of the control group (daytime mean values: SBP $P = 0.001$ and DBP $P = 0.049$; night-time mean values: SBP $P = 0.001$ and DBP $P = 0.003$).

Changes in antihypertensive medication

Antihypertensive treatment was administered to 54 patients in the football group and 55 in the control group. In the football group, therapy was reduced in 16 participants and intensified in three participants. In the control group, therapy was reduced in six participants, but intensified in 14 participants ($P < 0.001$). At the end of the study, five people in the football

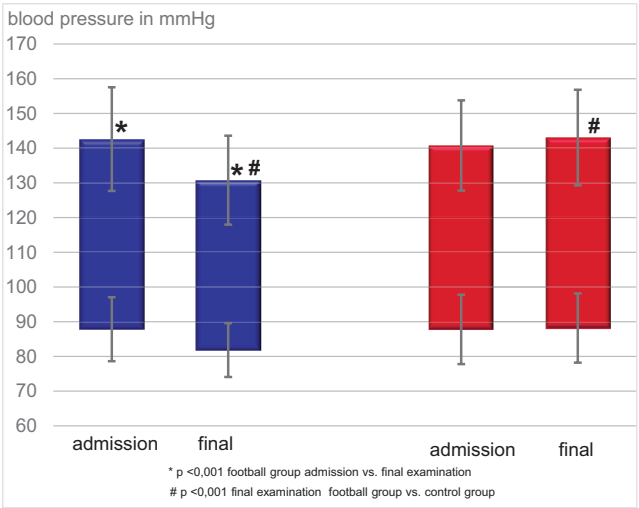

FIGURE 1 Office blood pressure in sitting position in football group (blue columns) and control group (red columns).

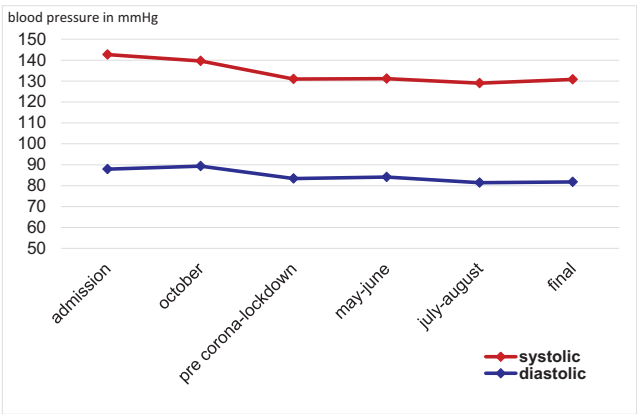

FIGURE 2 BP values in football group over the course of the study (admission between July and August 2019, Corona-lockdown between mid-March and Mid May).

TABLE 2. Ambulatory blood pressure monitoring values

ABPM mean values	Football group			Control group			
	Admission	Final	Sign.	Admission	Final	Sign.	Sign. between both groups at final examination
Systolic mean (SD)	125.71 (12.33)	120.73 (10.84)	$P < 0.001$	126.4 (10.57)	128.46 (14.46)	$P = 0.152$	$P < 0.001$
Diastolic mean (SD)	77.85 (7.49)	75.08 (6.59)	$P < 0.001$	77.93 (6.54)	78.18 (9.00)	$P = 0.756$	$P = 0.017$
HR mean (SD)	69.69 (9.3)	67.65 (9.65)	$P = 0.014$	69.86 (8.8)	69.81 (9.79)	$P = 0.986$	$P = 0.151$
ABPM daily values							
Systolic mean (SD)	129.47 (17.82)	125.31 (11.6)	$P = 0.014$	132.55 (13.49)	132.33 (14.41)	$P = 0.742$	$P = 0.001$
Diastolic mean (SD)	81.98 (7.73)	78.75 (7.05)	$P < 0.001$	81.75 (6.92)	81.36 (9.54)	$P = 0.840$	$P = 0.049$
HR mean (SD)	72.80 (10.14)	70.34 (10.03)	$P = 0.008$	72.67 (9.15)	73.47 (11.50)	$P = 0.637$	$P = 0.061$
ABPM night values							
Systolic mean (SD)	114.31 (20.35)	110.56 (15.56)	$P = 0.121$	115.91 (12.00)	119.08 (16.01)	$P = 0.153$	$P = 0.001$
Diastolic mean (SD)	70.17 (7.32)	67.47 (7.16)	$P < 0.001$	70.02 (7.40)	71.22 (9.04)	$P = 0.265$	$P = 0.003$
HR mean (SD)	63.40 (9.52)	62.17 (9.95)	$P = 0.308$	62.27 (8.93)	63.66 (10.58)	$P = 0.740$	$P = 0.340$

ABPM, Ambulatory blood pressure monitoring; HR, heart rate; no sign, differences in the admission between both groups.

group and only one person in the control group were no longer treated with antihypertensive agents.

Weight, nicotine, and laboratory results

According to the mean values, participants in the football group had a significant weight loss of 3 kg (from 99.5 to 96.5 kg), while those in the control group gained a significant mean weight of 1.7 kg (from 94.5 to 96.2 kg). A significant difference was observed within both groups and between the two groups ($P < 0.001$ in each case). There was no significant correlation between SBP reduction and weight reduction ($P = 0.524$). There was also no significant correlation between weight reduction and the training units performed ($P = 0.102$) or the duration of endurance exercise per week ($P = 0.307$). Three participants in the football group (from 12 to 9, NS) and one in the control group stopped smoking (from 9 to 8, NS).

As expected, only minor clinically irrelevant changes were observed in the laboratory values (Supplement Material, Table 2, http://links.lww.com/HJH/B708). In the control group, a significant reduction in the total cholesterol and LDL cholesterol levels was observed. This is due to the significant increase in statin therapy. In the football group, the protective HDL cholesterol levels significantly increased. LDL cholesterol also decreased by 5.2 mg/dl (control group, 6.4).

Complications and injuries

In football group, three patients developed internal complications [coronary heart disease with stenting (one), abdominal aortic aneurysm with stenting (one), atrial fibrillation (one), and encephalitis (one)]. None of these led to the drop-out of the study. The patient with abdominal aortic aneurysm terminated the training due to the Corona pandemic in particular. Internal complications in control group: six patients: coronary heart disease with NSTEMI (one), coronary heart disease with bypass surgery (one), atrial fibrillation (two), abdominal aortic aneurysm with stenting (one), hypertensive crisis, and (one) bladder carcinoma.

In the course of the study, 18 patients acquired minor injuries that did not lead to the termination of the study. These injuries only affected the lower extremity and were NS: stretched ligaments, twisted ankle (seven), strain (five), and torn muscle fibre (six). None of the injuries occurred during a duel, which was not allowed.

DISCUSSION

In the current study a modified football training resulted in a significant lowering of BP and a reduction in antihypertensive drugs in older high-risk patients with hypertension and without physical inactivity for several years. A reduction in BP and also in mortality through exercise has been well documented in hypertensive patients [8–11].

Playing football, like any adequately practiced sport, can reduce BP. However, the existing studies had only a small number of cases, were rated as methodologically insufficient, and usually included relatively healthy and younger people [6,7]. In a previous review, Eberl *et al.* cited that insufficient study quality, incomplete and only short follow-up, a high risk of bias, and a small study size with relatively high-dropout rates were major points of criticism. They concluded that the evidence was limited to short-term loss of body fat and an improvement in aerobic fitness. No conclusive results were found on any other health parameters [7]. The training corresponded to the typical competition-oriented football game and thus hardly minimi zed the risk of injury. Another problem is the lack of sustainability. And most of all there are only limited data in older patients with preexisting CVRF [7].

The participants in the 3F study are a risk group that has not been investigated in any study related to football. A significant reduction in BP within the football group and compared with the control group was achieved both in OBP and ABPM. In the football group BP slightly reduced after 3 months and was greatly reduced after more than 6 months. Furthermore, the number/dosages of antihypertensive medications can be reduced significantly more often in the football group. In contrast, significantly more antihypertensive patients were prescribed in the control group. Without this different change in medication, the difference in BP between football group and control group

could have been even more pronounced. This again underlines the effectiveness of football in lowering BP. Of course, the benefits are not exclusively due to football. A crucial point was that football motivated the participants to return to sport after many years of inactivity.

Decisive for participation in football group was with over 90% fun with the ball and playing football with the team. People who participate in other sports with the same motivation could achieve similar results. On the contrary, there are no comparative studies with different sports.

Another reason for the results could be an improvement in compliance. In particular, the team spirit could have been beneficial here. If compliance could be improved even further through football, a major goal would also have been achieved.

The mean BP reduction achieved here corresponds approximately to a BP reduction achieved with antihypertensive monotherapy and slightly exceeded the BP reduction usually achieved using general measures [8,9,12].

Synergistic effects of antihypertensive patients and playing football on lowering the BP are also conceivable. However, in this study, the untreated participants showed a BP reduction similar to that of the treated participants. It remains unclear whether football is more effective than other sports because of the variety of training demands, as there are hardly any comparative studies between different sports.

Many participants were significantly overweight at baseline. A reduction in BP through weight loss has been well documented [13]. According to the mean values, participants in the football group achieved a significant weight loss of 3 kg, while those in the control group gained a significant mean weight of 1.7 kg. Although BP decreased in some participants parallel to the reduction in weight, others showed a reduction in BP even without weight reduction. Overall, there was no significant correlation between weight loss and SBP reduction ($P = 0.524$). Even, for participants with a weight reduction of more than 2 kg, there was also no significant correlation between BP reduction and weight. The reason is the strong variation in the data, since BP lowering was achieved even in persons without weight loss. There was only a weak correlation for SBP in ABPM and weight loss with a correlation coefficient of 0.249 ($P = 0.019$). In this context, data from Moholdt *et al*. should be mentioned. Physical activity improved the survival rate of patients with coronary heart disease in all weight categories, while BMI was not associated with survival [14].

The optimal weekly amount of physical activity in high-risk patients is the subject of controversial discussion. Some studies showed that even significantly shorter training times than the recommended weekly activities (30–45 min, three–five times per week) have associated health effects. This is especially true when performing physical activities after a long break or with preexisting conditions, where even a small increase in physical activity improves the risk of disease [15–17]. For this group, extremely high training frequency is prohibited, especially at the beginning of the session. An important task of the trainer team, especially in the first months, was to curb the ambition of the participants.

The training format was developed specifically for this study to minimize the risk of injury as described in methods. During the further course only mild lower extremity discomfort was reported by 18 participants, which did not lead to discontinuation of participation in the study. It is worth mentioning that none of the participants was injured while performing tackles. The lower injury risk of this training format was also evident compared with conventional football participated by senior players. Hammes *et al.* [18] reported injuries in 18 senior football teams with 265 players documented over one season. A total of 63 players had 88 injuries. The frequency was 12.4 injuries per 1000 h, which was within the range of injuries reported among professional players. There was also an increase in the incidence of injuries with age. Even our participants were on average 11 years older, had a higher BMI, and an overall higher risk profile, injuries occurred significantly less frequent (less than 1 injury per 1000 h) and less severely.

The concept is likely to apply to women as well. This was checked in a small feasibility study with 36 women (18 control group and 18 football group). Therefore, women's teams are planned for future projects. Due to the small number, however, a statistically reliable statement is not possible.

Sustainability was ensured by conducting training in different clubs by licensed trainers with the same training content. In this way, the offer of 'health football' should be established in the long term, even after the end of the study. To our delight it is noted all five groups continued training in their clubs after the end of the study.

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Supplemental Material, http://links.lww.com/HJH/B708.

Conflicts of interest

The authors state that there are no conflicts of interest.

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