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Pathological Findings in Male and Female Semi-Professional Football Players from 11 to 14 Years—A Report of the Bavarian Football Association's Pre-Participation Screening Program

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Abstract: Pre-participation screening (PPS) in professional junior football is common practice. However, football players (FP) from non-professional football clubs may also be exposed to health risks, both internal and musculoskeletal. Therefore, the Bavarian Football Association (BFV) implemented a cardiological and orthopedic screening program for semi-professional FP in 2014. The purpose of this study was to obtain and present epidemiological data of pre-adolescent and adolescent semi-professional FP, including cardiac pathologies, past injuries, and orthopedic disorders. This study represents a retrospective analysis of semi-professional FP aged 11 to 14 years participating in the PPS program from 2014 to 2018, including their medical history, cardiac risk profiles, and the results of undergoing orthopedic and sports cardiology examinations. Overall, 362 male and 162 female FP could be included. More than 20% of the FP indicated suffering from one or more medical conditions. Cardiac abnormalities were reported in 30 (5.7%) FP. Further cardiological diagnostics were recommended for 3% of the FP due to findings while undergoing the PPS. Orthopedic disorders could be detected in 51 (9.7%) FP. Of the reported injuries, 44.3% could be categorized as overuse injuries. In order to guarantee extensive preventive sports medical care for semi-professional junior FP, a PPS concept should include a basic orthopedic examination in addition to cardiological screening due to a high rate of overuse injuries and cardiac abnormalities among pre-adolescent and adolescent FP. Further studies are needed in junior football to gain epidemiological data on injury occurrence and cardiac abnormalities on an amateur level to evaluate possible PPS programs, even on an amateur level.

Keywords: sudden cardiac death; junior football; preventive sports medicine; pre-participation screening; overuse injuries

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1. Introduction

Over the last decades, football evolved into the most popular sport worldwide. In 2020, the German Football Association (DFB) reported more than 1.3 million junior FP up to 14 years in Germany, with 250,000 of them in the state of Bavaria alone [1]. More and

more young FP regularly participate in training sessions and attend matches. All FP do benefit from practicing the sport by improving their cardiovascular and neurovegetative fitness. Thus, football significantly promotes a healthy lifestyle [2].

However, like in other sports, this involves not only a risk of musculoskeletal injury [2–6], but also the risk of cardiovascular incidents such as sudden cardiac arrest/sudden cardiac death (SCA/SCD). SCD represents the leading cause of death in young athletes [7,8]. It is defined as a sudden and unexpected fatality due to a physical condition of the heart which occurs immediately after showing the first symptoms [9]. The incidence of SCD for athletes under 35 years ranges from 0.3–3.6 per 100,000 per year [8,10,11]. Football seems to be the sport with the highest incidence of SCD, which can be explained by the high number of participants of the sport [12,13]. SCD results from structural or functional cardiac pathologies such as cardiomyopathies [14,15], as well as primarily electrical pathologies, such as genetically caused cardiac ion channelopathies, and others [12,16–18]. Preventive strategies have been developed in multiple countries to reduce the incidence of SCD among junior FP [11,19–21], including the Bavarian Football Association (BFV; see Table 1) [22].

Table 1. Overview of different preventive sports medicine concepts.

	BFV [1]	FIFA [2]	Italy [3]	Austria [4]	AHA [5]	ESC [6]
Medical history	+	+	+	+	+	+
Physical examination	+	+	+	+	+	+
ECG	+	+	+	+	-	+
Echocardiography	+	+	-	-	-	-
Ergometer	-	+	+	-	-	-
Repetition	profiles + risk profile 'SCD', annual update	ECG annually, Echo + Ergo, if required	Complete screening annually	Every two years at least	Every two years	Every two years at least
Special features	'J1', blood pressure, pulse oximetry, risk protocol 'SCD', ECG criteria, special emphasis orthopedic examination	emergency plan	spirometry	ECG-criteria, emphasis orthopedic examination		ECG criteria, blood pressure

[1] sports medicine concept of the regional football academies of the Bavarian Football Association (BFV) [22]; [2] FIFA 11 Steps to Prevent Sudden Cardiac Death [23]; [3] Italian legal decree of 1971 and 1982 [24,25]; [4] Recommendations of the Austrian Society of Sports Medicine and Prevention (ÖGSMP) and Austrian Society of Pediatrics (ÖGKJ) [26,27]; [5] Recommendations of the American Heart Association (AHA) [28–30]; [6] Recommendations of the European Society of Cardiology (ESC) [19].

The upcoming generation tends to a lower average fitness level, with higher numbers of children and adolescents participating in this sport. Therefore, a higher incidence of injuries, especially overuse injuries, is very likely [31]. In general, football has a relatively low risk of major injuries within youth ages. The injury incidence and types of injury differ between preadolescent and adolescent players due to diverse biomechanical settings of the musculoskeletal system. That is the reason why children aged 7 to 12 years are unlikely to sustain overuse syndromes or ligament injuries but more often suffer from bone fractures of the long bones [32,33]. Notably, pre-adolescents sustain less muscle injuries than adults because forces on muscle during training or match exposure are transferred to and neutralized in cartilage, ligaments, or bones [32]. The weak point of pubescent athletes is the physis with its metaphyseal hyperplasia zone which more often results in epiphyseal injuries. The overall injury risk increases with age [2]. The injury incidence of adolescent players (aged 13–19) ranges from 2–7/1000 h of football exposure and is significantly higher than the one of pre-adolescents. Over all age groups of junior FP, the most affected body

region is the lower leg with 60–90% [2]. Loose et al. showed a higher incidence of overuse injuries in semi-professional junior football than in adult players of the same skill level [34]. The presented epidemiology and incidence of injuries among junior FP illustrates the risk to which this age group is exposed.

Just recently, Robles et al. emphasized the importance of primary and secondary prevention of SCD in the form of pre-participation screening (PPS) [35]. The effectiveness of PPS has already been confirmed by Corrado et al. for the example of the Italian cardiological PPS by reducing the annual incidence of SCD by 89% [24,25,36]. Regarding orthopedic screening, the benefits of PPS have yet to be proven. However, Palermi et al. could demonstrate that a short standardized clinical examination can already reveal musculoskeletal abnormalities among children [37]. There is consensus among sports physicians about the importance and the necessity of PPS programs, but dissent arises when it comes to methods and the extent of diagnostics (see Table 1). The BFV's PPS concept was developed by the FIFA Medical Centre of Excellence Regensburg (FMCE) and was implemented for the first time in 2014. In addition to the athlete's profile and taking a general and specific medical history, it includes clinical and instrumental diagnostics. The PPS program addresses the talents of the football academies of the BFV who are playing on a semi-professional level. The idea of those regional football academies is to provide talent promotion near to their homes [38]. Not playing on a professional level, the FP have not benefitted from medical screening programs so far, who are provided by the junior division of professional clubs. With this in mind, the BFV's PPS program closes a gap of additional health care, which has previously been wide open.

The objective of this study was to obtain and present epidemiological data of semi-professional junior FP. These data consist of the results of undergone screening examinations and the FP's medical history like past injuries or known medical conditions. By presenting the PPS results, awareness should be risen for PPS in junior football, and not only on a professional level.

2. Materials and Methods

2.1. Design

This retrospective analysis reports epidemiological data, including cardiac risk profiles and medical histories of semi-professional junior FP, on the basis of the data collected throughout the BFV's screening program during the first five years since its implementation in 2014.

2.2. Study Population

The participants of the present study are members of the regional selection team of the BFV. There were 80 members of those selection teams per season and age group. They get picked after undergoing a scouting process which lasts one to two seasons prior. In total, 240 male FP from 11 to 14 years and 160 female FP from 12 to 14 years play annual comparative tournaments with their selection team. Thus, 400 FP were given the opportunity to voluntarily participate in the BFV's screening program each season. From 2014 to 2018, 362 male and 162 female respondents could be included in total (n = 524). The mean age of the players was 12.8 years (see Table 2). One could participate if the FP did not display any current subjective symptoms when undergoing the screening process or if he or she is under no current physical or medical therapy which deviates from his or her permanent medical therapy (e.g., iodid substitution, methylphenidate). The classification of orthopedic/traumatological injuries as "overuse injuries" and "traumatological" was based on the classification of the different injury types by Hägglund et al. [39], which is modified after Orava [40], defining an overuse injury as a pain syndrome of the musculoskeletal system with insidious onset and without any known trauma or disease that might have given previous symptoms.

Table 2. General data of the study population.

Male/Female	*n* (%)		362 (69.1)/162 (30.9)
Age (In Years)	mean (SD)/min–max		12.8 (0.8)/11–14
Height (In cm)	mean (SD)/min–max		163.3 (±9.6)/140–191
BMI (kg/m^2)	mean (SD)/min–max		18.8 (±1.9)/14.2–26.6
Position on Field	*n* (%)	goalkeeper	50 (9.5)
		defender	137 (26.2)
		midfielder	249 (47.6)
		striker	88 (16.7)

2.3. Screening Examinations

The modules of the BFV's screening program are shown in Table 3. They include internal, cardiological, and orthopedic examinations. If cardiac risk factors appear, additional assessment is recommended (stress-electrocardiography (ECG), Holter-ECG) on top of the basic cardiological examinations, which are an ECG and a transthoracic echocardiography (TTE). The 'J1' is a German routine screening examination for adolescents from 12 to 14 years. It has to be performed by general practitioners or pediatricians and is covered by health insurance companies. It consists of taking the medical history as well as basic examinations like measuring height, weight, and blood pressure, and checking the pubertal development.

Table 3. Screening modules of the BFV's preventive sports medicine concept. SCD—Sudden Cardiac Death, ECG—electrocardiography, TTE—transthoracic echocardiography, * German youth screening examination.

Medical History	Athlete's profile Risk profile 'SCD'	anthropometric data (height, weight) position on field relevant medical history allergies/intolerances medication specific questionnaire regarding risk factors for SCD of the athlete's family
Clinical Examination		medical checkup 'J1' * orthopedic examination
Instrumental Diagnostics		sports cardiology examination (ECG, TTE) if risk factors appear stress-ECG/extended period-ECG

2.4. Risk Profile for SCD

This questionnaire, which represents a modified questionnaire of the Section on Cardiology and Cardiac surgery of the American Academy of Pediatrics [8], was designed to identify young athletes with potential risk for SCD and was first implemented in 2014. It includes nine Yes/No questions which cover not only the athlete's medical history but also the athlete's family's medical history with focus on indicators for structural or electrical cardiac abnormalities (see Appendix A). If any question is answered "Yes", a free response must be formulated [22]. The FP were asked to include their legal guardians when filling out the questionnaire.

2.5. Data Collection

All data were collected, and all examinations were performed after obtaining the consent of the participants and their legal guardians including their consent on publishing the PPS results. The study is in compliance with the Declaration of Helsinki and was approved by the institutional review board of the University of Regensburg (15-101-0079). Players and parents were informed about the PPS program by the BFV officials and also received

the questionnaires in this way. The questionnaires consisted of a player profile and the risk protocol, as mentioned above. In the years of 2015 and 2016, the BFV's PPS program was performed on-field. This means that both the data collection (medical history forms and risk profiles) and the cardiological and orthopedic examinations took place during an annual tournament of the participating junior teams. The clinical and instrumental diagnostics were performed by specialists of the FMCE. The clinical and instrumental cardiological examinations were performed by specialized pediatric cardiologists. Orthopedic examinations were conducted either by orthopedists or by well-experienced and trained sports physicians, although the on-field screening program could not be offered to all teams due to high time and personnel expenditure (maximum of approximately 200 athletes per season). In the study phase of decentralized data collection (2014, 2017, and 2018), players were asked to have the examinations performed independently by an appropriate specialist and to submit the respective doctor's letters. The various examinations were only considered to be performed if a copy of the same or a medical certificate of the examination was available.

2.6. Statistical Analysis

Statistical analysis was performed with SPSS® (Version 25, IBM, Armonk, NY, USA). Data were presented as mean ± SD or absolute and relative frequencies. Graphical illustrations were generated with GraphPad Prism® (Version 5.01, GraphPad Software, La Jolla, CA, USA) and Microsoft Powerpoint 2013® (Microsoft Corporation, Redmond, WA, USA).

3. Results

Medical history has been categorized as cardiological, further internal medical, traumatic, overuse injury, and further orthopedic disorders. Of the semi-professional FP, 114 (21.8%) indicated suffering from one or more internal medical conditions. Concerning orthopedic medical history, 51 (9.7%) athletes suffered from chronic orthopedic disorders.

3.1. Cardiological and Further Internal Conditions

In total, 30 (5.7%) FP suffered from cardiological problems and 30 FP (5.7%) suffered from further internal problems (see Table 4). Among the cardiac abnormalities, the first-grade mitral valve insufficiency (n = 7; 1.3%) was the most common, followed by atrial septal defect (n = 5; 1.0%). Of the cardiological conditions, 15 cases (50%) have been detected only by echocardiography, 9 (30%) by ECG, five (16.7%) due to medical history, and one (3.3%) by physical examination. Based on the screening results, 15 (2.9%) of the examined FP were recommended for detailed cardiological evaluation. First-degree mitral valve insufficiency (n = 7) and left ventricular hypertrophy (n = 1) required periodical TTE monitoring. For FP with newly diagnosed congenital coronary anomaly (n = 2) or arterial hypertension (n = 1), a stress test was recommended. In the case of ectopic beats (n = 1), WPW pattern (n = 1) and other cardiac arrhythmia (n = 2), further cardiological diagnostics were carried out according to the recommendations of the current ESC guidelines. Concerning the results of the cardiological examinations, no FP was found to be excluded from competitive sports after detailed cardiological workup.

Of all participants, 20 subjects (3.8%) suffered from bronchial asthma, which represents the most common internal disease in this study population. In the player profile, 79 (15.1%) of all players stated that they had an allergy, with 9 (1.7%) players suffering from several different allergies. The most common allergies among our cohort of junior FP include pollen allergy (10.1%), food allergy (2.5%), and house dust allergy (1.9%).

Table 4. Cardiological and further internal conditions among the participants, indicated as number of cases (*n*), ordered by frequency, and given as a percentage of the total study population (%).

Cardiological Conditions	*n*	% (*n*/Total)	Further Internal Conditions	*n*	% (*n*/Total)
Mitral valve insufficiency (Grade I)	7	1.3	Bronchial asthma	20	3.8
Atrial septal defect	5	1.0	Infantile seizures	3	0.6
Complete right bundle branch block	3	0.6	Adrenogenital syndrome	2	0.4
Ventricular septal defect	2	0.4	Familial hypercholesterolemia	1	0.2
Cardiac arrhythmia (not further specified)	2	0.4	Migraine	1	0.2
Postural hypotension	2	0.4	Type I diabetes mellitus	1	0.2
Dilated right main coronary artery	1	0.2	Von Willebrand disease	1	0.2
Arterial hypertension	1	0.2	Hypothyroidism	1	0.2
Left ventricular hypertrophy	1	0.2			
Coronary artery fistula	1	0.2			
Aneurysm of atrial septum	1	0.2			
WPW pattern	1	0.2			
Bicuspid aortic valve	1	0.2			
Ectopic ventricular beats	1	0.2			
Dilation of ascending aorta	1	0.2			

3.2. Cardiac Risk Profiles for SCD

Of the total 524 respondents, 402 participants (76.7%) completed the cardiac risk profile. The majority of the study participants (72.9%) did not show any potential risk factors, but 109 FP (27.1%) showed at least one potential risk factor for SCD. The most common question of the risk profile which was answered "yes" was if there had been a recommendation for further cardiological diagnostics at any time in the past (n = 36; 9.0%) or a previous cardiological examination (n = 20; 5.5%). Reasons for a detailed cardiological workup in the past are listed in Table 5.

Table 5. Reasons for previous cardiological diagnostics in study participants, expressed as a percentage of the total risk profiles received (n = 402).

Reasons for Cardiological Diagnostics in the Past	*n*	% (*n*/Total)
Heart murmur	9	2.2
Atrial/Ventricular septal defect	6	1.5
First-degree relative with complex congenital heart defect	3	0.7
Reason no longer remembered or not specified	2	0.5

Abnormalities of the medical history of the players family were reported by 42 (10.4%) young athletes. Of those, 24 (6.0%) reported relatives with relevant cardiac arrhythmias (mostly grandparents), and of those, 15 had been fitted with pacemakers. In addition, there was a number of first-degree relatives with previous myocardial infarction (n = 12) and stent implantations or bypass operations performed in coronary heart disease (n = 5). In seven cases, first-degree relatives with congenital heart defects were mentioned, among them siblings of the players (n = 3).

3.3. Traumatic and Orthopedic Conditions

Fractures and ligament injuries represent the most frequent traumatic injuries, followed by muscle injuries (fractures/ligament injuries: n = 33; 6.2%; muscle injuries: n = 5;

1.0%; see Table 6). The most common chronic orthopedic conditions were foot deformities (n = 18; 3.4%), followed by idiopathic scoliosis (n = 15; 2.9%). The share of overuse injuries in the total number of traumatic injuries is 44.3% (n = 35).

Table 6. Traumatic and overuse injuries as well as orthopedic disorders, indicated as number of cases (n), ordered by frequency, and given as a percentage of the total study population (%).

Traumatic Injuries	*n*	%	Overuse Injuries	*n*	%	Orthopedic Disorders	*n*	%
Fractures	19	3.6	Osgood-Schlatter's disease	7	1.3	Foot deformities	18	3.4
Ligament ruptures	10	1.9	Lower back pain	6	1.1	Scoliosis	15	2.9
Ligament strain	4	0.8	Tendinitis/Tendon irritation	6	1.1	Coxa/Genua valga/vara	6	1.1
Muscle strain	3	0.6	Shortened hamstring muscles	4	0.8	Thoracic deformities	6	1.1
Muscle fiber rupture	2	0.4	Epiphyseolysis	2	0.4	Unequal leg length	3	0.6
Ankle joint distortion	2	0.4	Apophysitis calcanea	2	0.4	Pelvic misalignment	2	0.4
Meniscus rupture	1	0.2	Bone edema	1	0.2	Osteochondroma	1	0.2
Bone bruise	1	0.2	Plica syndrome	1	0.2	Osteochondroma	1	0.2
Capsule injury	1	0.2	Growing pains	1	0.2			
Head trauma	1	0.2	Osteochondrosis dissecans	1	0.2			
			Chondromalacia patellae	1	0.2			
			Spondylolysis	1	0.2			
			Scheuermann's disease	1	0.2			
			Knee joint effusion	1	0.2			

3.4. Medication

In the determination of a regular medication intake, this was confirmed by 6.1% of all participants. Figure 1 shows the type of medication taken by the players. In line with the frequency of allergological and pneumological pre-existing conditions, medication for allergies (2.3%) or bronchial asthma (1.9%) was reported most frequently.

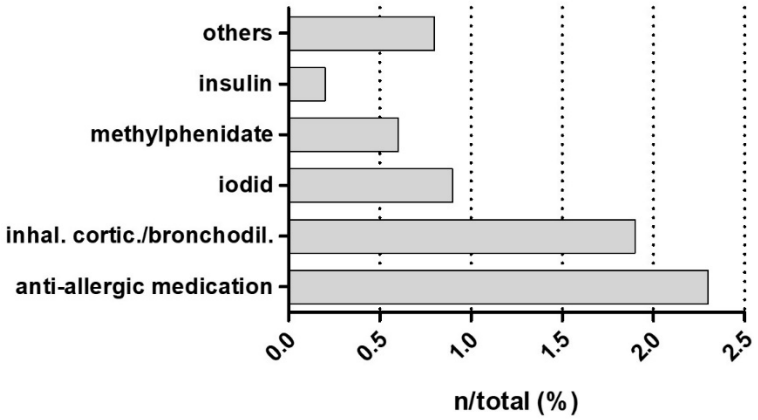

Figure 1. Listing of regular medication, indicated as a percentage of total study population (%).

4. Discussion

The current literature does not provide a satisfactory number of studies with similar conceptualization to compare our results concerning prevalence of cardiac risk factors or cardiac abnormalities. Most of the epidemiological studies presenting data of cardiac PPS emphasize elite junior FP or differ in the extent of instrumental diagnostics. The purpose of this study was to obtain and present epidemiological data of pre-adolescent and adolescent semi-professional FP including cardiac pathologies, past injuries, and orthopedic disorders. The main findings of this retrospective analysis are the following: among the respondents of the BFV's PPS program, more than 20% indicated suffering from one or more medical

conditions. Concerning orthopedic conditions, nearly 1 out of 10 FP suffered from chronic orthopedic disorders. Fractures and ligament injuries have been reported most frequently among traumatic injuries (6.2%), followed by muscle injuries (1.0%). More importantly, the share of overuse injuries in the total number of traumatological conditions is more than 40%.

The results from Table 4 show that cardiac abnormalities could be detected in 1 out of 20 (5.7%) semi-professional junior FP, either by querying the medical history (16.7%) or by instrumental (80%) or clinical (3.3%) examination. This represents a significant share, especially because the subjects did not show any documented symptoms or had not previously experienced any performance impairment. Remarkably, none of the detected cardiac and further internal medical conditions resulted, in exclusion from competitive sports. Although thirteen (3%) of the examined FP were recommended for a detailed cardiological or internal evaluation based on the screening results, there were no direct therapeutic consequences for these players.

Schmied et al. presented their findings of a pre-competition cardiac assessment including medical history, clinical examination, resting-ECG and TTE among 155 male elite Under-17 FP. The rate of FP who needed further follow-up investigation due to the PPS was higher (8.4% vs. 3.0%), but there was also no exclusion from competition [41]. The results of the current study indicate that 15 out of 30 (50%) cardiac abnormalities could only be detected by TTE (see Table 4), and even required further investigation in some cases. This fact suggests that adding TTE on top of ECG (30%) for the screening of structural heart defects can be of great value when it comes to cardiological PPS. Gerling et al. have been able to detect coronary artery anomalies throughout a PPS program for elite junior FP [42]. The listed cardiological conditions in this study are almost exclusively of genetic origins, which would suggest that the prevalence can be considered equally among young FP, no matter what level of performance the FP belongs to.

The epidemiological data presented by this survey further indicate that there is a need for internal and orthopedic PPS. A focused clinical examination is expeditious, requires low financial resources, and can detect chronic orthopedic conditions like foot deformities or scoliosis [37], which represent the two most common chronic orthopedic conditions (65.7%, see Table 6) in youth. It is striking that overuse injuries account for a significant proportion (44.3%) in this age group of 11 to 14-year-olds. Overuse injuries occur even more often than fractures or ligamentous injuries together (n = 35 vs. 33). Although the incidence of overuse injuries as a proportion of the general incidence of injuries has not yet been adequately clarified, it is very likely to increase in the future due to a lower average fitness level of the younger generation and an increasing number of children and adolescents participating in competitive sports [31].

Faude et al. deduced from their review that in adolescent football, between 60% and 90% of the injuries were categorized as traumatological, whereas 10% to 40% were overuse injuries [2]. This statement can be supported by the present investigation. Furthermore, Loose et al. showed a higher incidence of overuse injuries in semi-professional junior football compared to adults of the same performance level [34]. They reported an incidence of overuse complaints as 7.4 in 1000 h of football exposure for semi-professional junior FP. Rommers et al. found a positive correlation between the increase of leg length per year and the risk of overuse injuries in junior elite FP [43].

Having this in mind, FP who are in a growth spurt might be at an increased risk of suffering from overuse syndromes. Therefore, this group of adolescent athletes needs increased attention when it comes to primary prevention. In this survey, fractures and ligament injuries represent the most frequent traumatic injuries (6.2%), followed by muscle injuries (1.0%). Generally, junior FP have even higher injury rates during training sessions than adults [44]. Of course, compared to adult players, the overall incidence of injury is lower among junior FP [2], but it seems that non-contact injuries, as they occur more frequently during training, are a greater proportion of the total injury frequency for this population and, consequently, there is a higher primary preventive potential for such non-

contact injuries. A regularly performed clinical examination can serve as a basic preventive measure, as it can detect potential poor posture or incorrect loading prior to the occurrence of an acute injury or overuse syndrome.

This study is subject to limitations that must be considered when interpreting its results. First of all, the study population is somewhat broadly based. An eleven-year-old male FP and a fourteen-year-old female FP may differ vastly in their pubertal physical development, and therefore the study population under investigation is quite homogeneous in terms of physical and cardiac resilience and susceptibility to internal disease or injury. Furthermore, clinical orthopedic examination results are subject to examiner bias due to alternating specialists performing the examinations. In the case of TTE, the examinations were performed by only one specialist (S.G.) to avoid further bias. The on-field screening program could not be offered to all FP of all teams due to personnel expenditure. In addition, the data of the FP's medical history do not originate from physicians themselves, but from the FP and his or her legal guardians. Therefore, information about the FP's former or current medical conditions might be imprecise in some cases. Even though the data originate from 2014 to 2018, the data cannot be considered out of date. Data collection was terminated at the onset of the SARS-CoV-2 pandemic due to the infrastructural expense of testing and data acquisition during the pandemic, and the recruitment of FP was increasingly implemented. Additionally, the prevalence of cardiological conditions would have been reported as false positive, whereas the injury incidence would have been a false negative due to generally reduced football exposure during the pandemic. Nevertheless, the survey shows representative and valid data concerning internal and cardiac abnormalities in particular, as well as frequency of past injuries and current orthopedic disorders from semi-professional junior FP.

5. Conclusions

The frequency of cardiac abnormalities, as well as the prevalence of risk factors for SCD among the study participants, highlights the need for a PPS for semi-professional junior football players. In addition, the relevant share of overuse injuries among traumatological and orthopedic conditions emphasizes the necessity of an additional basic orthopedic/musculoskeletal screening as part of such PPS. The implementation of PPS programs in junior popular sports is of utmost importance due to the already proven benefits to be expected of such programs. This study should once more raise awareness for the importance of PPS programs in popular sports such as football, and it should serve as a solid argument and encouragement for those responsible for public health to implement PPS programs not only on a professional and semi-professional but also on an amateur level. Thus, further studies are needed to clarify both the incidence and genesis of injuries and overuse injuries in junior amateur football, and to survey the prevalence of pre-existing cardiac conditions to work out the potential and necessity for pre-participation screening programs for this level of performance.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki, and approved by the Institutional Ethics Committee of the University of Regensburg (15-101-0079).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study and their legal guardians.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to privacy and ethical reasons.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Risk profile for Pediatric Sudden Cardiac Death

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Surname, First Name, Date of birth, Mobile

Athlete's medical history:

1. Did your child become dizzy or even faint **during** or **after** physical exertion, an emotional event, or a scare? ☐ yes ☐ no
2. Has your child ever complained of extreme shortness of breath or discomfort, pain or pressure in his or her chest during or after physical exertion? ☐ yes ☐ no
3. Has your child ever complained of fatigue during physical exertion (unlike other children)? ☐ yes ☐ no
4. Has a doctor recommended or performed a heart exam on your child at any time? ☐ yes ☐ no
5. Has your child ever been diagnosed with an unexplained seizure or does your child suffer from exertional asthma that is not well treated with medication? ☐ yes ☐ no

Family history

6. Are there any members in your family who have had a sudden, unexpected, unexplained death before their 50th birthday (included sudden infant death, traffic accident, drowning accident, or near drowning)? ☐ yes ☐ no
7. Are there any family members who died suddenly before their 50th birthday because of heart problems? ☐ yes ☐ no
8. Are there family members who have unexplained dizziness or seizures? ☐ yes ☐ no
9. Are there any relatives with special medical conditions, e. g. thickened heart muscle, enlarged heart, cardiac arrhythmia, Marfan syndrome, heart attack (under the age of 50), pacemaker or defibrillator implantation, deafness at birth? ☐ yes ☐ no

For each question answered "yes," please describe the exact circumstances:

.....

.....

.....

The sheet was filled out by

☐ Mother ☐ Father ☐ Athlete ☐ Others

Modified after:

Pediatric Sudden Cardiac Arrest

Pediatrics 2012;129

Stephan Gerling, MD

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