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Functional and Motor Deficits in Youth Soccer Athletes – An Explorative, Quasi-Experimental Study

Funktionelle und motorische Defizite bei Nachwuchsfußballspielern – eine explorative, quasi-experimentelle Studie

Summary

- **Background & Aim:** Little is known about functional and motor deficits in male soccer players aged 9-13 and the impact they have on sports injuries and the prevention thereof. Hence, this study assesses functional and motor deficits in the aforementioned population and investigates the effects of an individualized training intervention on functional and motor deficits.
- **Methods:** This explorative, quasi-experimental study design allocated male soccer players (9-13 years) (n=48) into intervention group (n=23) and control group (n=25). Both groups performed the functional movement screen, toe touch test and weight-bearing lunge test pre-intervention and post-intervention. The intervention group performed a 12-week multimodal training intervention twice per week for 10-15 minutes. The total score of the functional movement screen and the results of the toe touch test and weight-bearing lunge test served as the outcome parameters.
- **Results:** We identified a variety of functional and motor deficits. All participants improved their total score of the functional movement screen ($F(1)=32.27$; $p<0.001$; $peta^2=0.42$), toe touch test ($F(1)=10.48$; $p<0.01$; $peta^2=0.19$) and weight-bearing lunge test ($F(1)=8.46$; $p<0.01$; $peta^2=0.16$). The intervention group showed higher improvements for the functional movement screen ($F(1,46)=4.46$; $p<0.05$; $peta^2=0.09$), toe touch test ($F(1,46)=10.48$; $p<0.01$; $peta^2=0.19$) and weight-bearing lunge test ($F(1,46)=8.46$; $p<0.01$; $peta^2=0.16$).
- **Conclusion:** A 12-week multimodal training intervention can effectively reduce functional and motor deficits identified in male soccer players aged 9-13 years and might serve as a helpful tool in injury prevention.

Zusammenfassung

- **Hintergrund und Ziel:** Bislang befassten sich nur wenige Studien mit funktionellen und motorischen Defiziten und deren Konsequenzen auf das spätere Verletzungsrisiko bei Fußballspielern im Alter von 9-13 Jahren. Ziel dieser Studie war die Identifikation möglicher motorischer Defizite und die Erprobung einer individualisierten Intervention zur Reduktion erfasster motorischer Defizite
- **Methode:** Die explorative, quasi-experimentelle Studie untersuchte männliche Fußballathleten (9-13 Jahre; N=48) mit einer Interventions- (n=23) und einer Kontrollgruppe (n=25). Die Untersuchungen umfassten den Functional Movement Screen Test (FMS), den Toe Touch Test und den Weight-Bearing Lunge Test im Pre-Post-Design. Die Interventionsgruppe absolvierte ein 12-wöchiges individualisiertes Trainingsprogramm zwei Mal pro Woche für 10-15 Minuten. Der Summenscore des FMS sowie die Ergebnisse des Toe Touch Test und Weight-Bearing Lunge Test wurde als Outcome-Parameter analysiert.
- **Ergebnisse:** Es konnte eine Vielzahl an motorischen Defiziten identifiziert werden. Alle Fußballer verbesserten den Gesamtscore des FMS ($F(1)=32.27$; $p<0.001$; $peta^2=0.42$), Toe Touch Test ($F(1)=10.48$; $p<0.01$; $peta^2=0.19$) und Weight-Bearing Lunge Test ($F(1)=8.46$; $p<0.01$; $peta^2=0.16$). Die Interventionsgruppe zeigte hierbei höhere Verbesserungen für den FMS ($F(1,46)=4.46$; $p<0.05$; $peta^2=0.09$), den Toe Touch Test ($F(1,46)=10.48$; $p<0.01$; $peta^2=0.19$) und den Weight-Bearing Lunge Test ($F(1,46)=8.46$; $p<0.01$; $peta^2=0.16$).
- **Fazit:** Eine 12-wöchige individualisierte Trainingsintervention kann effektiv funktionelle und motorische Defizite bei männlichen Nachwuchsfußballern im Alter von 9-13 Jahren reduzieren und somit ein hilfreiches Instrument zur Verletzungsprophylaxe darstellen.

KEY WORDS:
Motor Deficits, Youth Soccer, Injury Prevention, Flexibility, Training Intervention

SCHLÜSSELWÖRTER:
Motorische Defizite, Nachwuchsfußball, Verletzungsprävention, Beweglichkeit, Trainingsintervention

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Introduction

Soccer is characterized by quick accessions, short sprints, abrupt stops, changes of direction, jumps, landings, kicks and duels (29). Over the last decades, imposed by sports-related demands, physical stress and strains on the body for soccer athletes have risen (4, 28) and injury prevention has gained more importance.

Many soccer specific injuries occur already in younger athletes and children under the age of 15 are especially at risk (27, 21). A recent meta-analysis (14) has shown a correlation of increasing training loads and increasing injury rates across a variety of sports, thus calling for effective injury prevention strategies at times of increasing training loads, for example in young athletes. Age has been identified as another important risk factor for injury incident in soccer players (2). Moreover, a variety of studies discussed flexibility as a risk factor for sports injury (24), but findings are still inconsistent.

Previous studies examined possible prevention strategies (9, 26) in subjects aged 14-18 years. In a meta-analysis, Rössler et al. (26) concluded that exercise-based injury prevention programs are effective in reducing injury rates in youth sports. However, there is a considerable lack of data for children (under 14 years), boys (representing only 12.7 % of the overall study population), and for individual sports (26).

Overall, little is known about deficits in motor performance in male soccer players under the age of 14. Hence, the aim of this study is to identify functional deficits in male child soccer players.

We hypothesize that male child soccer players already show functional and motor deficits. Furthermore, we explore the effect of an individualized multimodal training intervention on functional deficits in male child soccer players. We hypothesize that a multimodal training intervention affects previously identified functional deficits. Thus, this study tries to give new insight for a prevention strategy of sports injuries in soccer players under the age of 14.

Methods

Design

This explorative, quasi-experimental study design compared two groups of male child soccer players (INT, n=23 & CON, n=25). Subjects performed a pretest and posttest to assess functional deficits. In-between both tests, the intervention group (INT) completed an individualized multimodal training intervention as a warm up at the beginning of their regular soccer practice. The control group (CON) only performed both tests and participated in their regular soccer practice. The study period was February to June 2017.

Subjects

Male subjects free of any pain or injuries were recruited via personal contacts with the FC St. Pauli soccer club in Hamburg (U10, U11, U12 and U13).

Subjects were divided into an intervention group (INT n=23, U11 & U13) and a control group (CON n=25, U10 & U12) in correspondence with their coaching staff. Subjects (n=3) who suffered an injury or missed a training session were excluded from the study.

Anamnesis

Anamnesis of anthropometric data occur prior to the testing procedure commonly used at the FC St. Pauli. The leg length was measured from the floor to the anterior superior iliac spine, tibia length was measured from the floor to the proximal end of the tibial tuberosity. The hand length was measured from the wrist crease to the tip of the third digit. Participants were asked about their dominant hand and leg. n=40 participants had the right leg as the dominant leg and n=8 (INT n=7; CON n=1) the left.

Instruments

The functional movement screen (FMS) (7, 12, 13) was performed to test flexibility, coordination and asymmetries (19). The FMS in its entirety, including judgement criteria, has been well described (12,13,20). Additionally, participants performed the

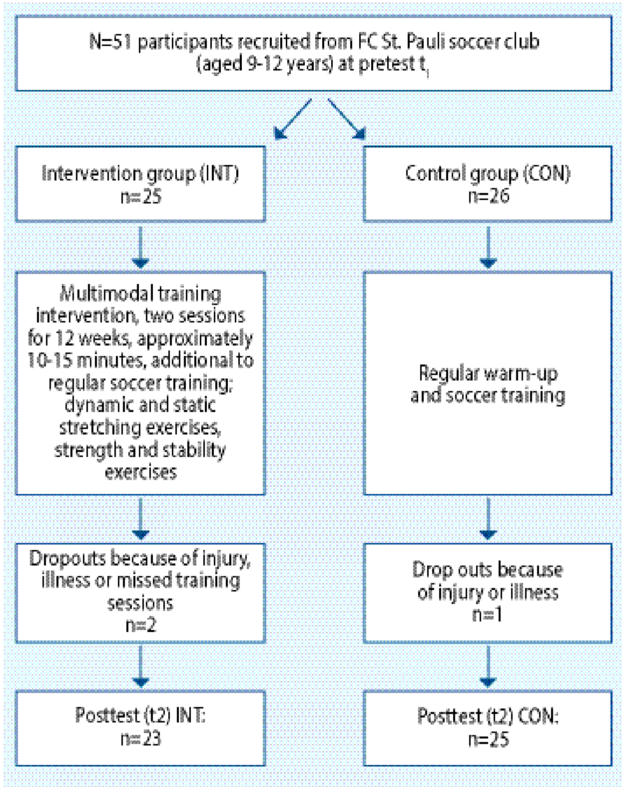

Figure 1

Study flow. INT=intervention group; CON=control group.

toe touch test (TT) to assess the flexibility of the hamstrings and the spinal erectors (3) and the weight-bearing lunge test (WBLT) to assess the dorsiflexion of the ankle joint. It is characterized by robust quality criteria (11, 16).

Testing procedure

The FMS, TT and WBLT are common practice in the club and part of the general performance assessment. Therefore, the participants and their parents were acquainted with the testing procedure of the study. For the TT, participants received a standardized instruction to completely extend their knees while standing and then touch their toes with their hands. The test was judged as "positive" or as "negative", depending on the ability to touch the toes with the hands. For the WLBT (both sides) participants were instructed to place one of their feet ten centimeters away from a wall, with their heel on the ground, toes pointing towards the wall. They were then asked to bend the corresponding knee forward against the wall, without elevating the heel. The test was either judged as "positive" or as "negative", depending on the ability to touch the wall with the knee, without elevating the heel.

Subjects were introduced and familiarized with the tests. Oral consent to the procedure of the tests was given by all subjects followed by the anamnesis. During a standardized procedure the correct execution of all seven movements of the FMS was demonstrated and participants completed the FMS. Afterwards TT and the WBLT were performed.

Intervention

INT received an individualized 12-week multimodal training intervention, twice per week for 10-15 minutes as a warm-up at the beginning of the regular soccer practice instead of their usual warm-up routine. According to individual functional deficits analyzed by pre-test data, an individualized training ›

Table 1

Anthropometric data of the sample at t1, t2 and the functional deficits identified by FMS, TT or WBLT in the sample at t1, number of participants per group with the specific deficits and corresponding exercises employed in the multimodal training intervention. Given are means and standard deviation. INT=Intervention group; CON=Control group; t1=day of the pretest; t2=day of the posttest; BMI=Body Mass Index; cm=centimeter; kg=kilogram; FMS=Functional Movement Screen; TT=Toe Touch Test; WBLT=Weight Bearing Lunge-Test; sec=seconds.

ANTHROPOMETRIC DATA	INT (N=23)		CON (N=25)		TOTAL (N=48)	
	T1	T2	T1	T2	T1	T2
Body height/cm	154.44	156.00	148.52	149.24	151.35	152.48
	±9.13	±9.11	±10.52	±10.96	±10.22	±10.57
Body mass/kg	42.71	43.05	39.38	39.61	40.98	41.62
	±5.96	±6.08	±8.33	±8.50	±7.41	±7.56
Age/years	11.44	11.87	10.28	10.84	10.83	11.33
	±0.73	±0.87	±1.21	±1.18	±1.16	±1.16
BMI	17.85	17.64	17.67	17.61	17.76	17.62
	±1.39	±1.50	±2.00	±2.07	±1.72	±1.80
NUMBER OF IDENTIFIED FUNCTIONAL DEFICITS				CORRESPONDING EXERCISES FOR INT GROUP		SETS X REPETITIONS OR DURATION/SEC
1) Limited hip and knee flexion & ankle dorsiflexion	n=20		n=19	Ankle Mobility Calf Stretch Assisted Squat		2 x 10 repetitions 2 x 10 repetitions 2 x 10 repetitions
2) Poor stance-leg stability of ankle, knee and hip and poor balance	n=15		n=16	Balance Stick		2 x 8 repetitions
3) Limited hip extension and hip mobility	n=18		n=17	Hamstring Kicks Balance Stick		2 x 10 repetitions 2 x 8 repetitions
4) Limited rectus femoris flexibility	n=10		n=7	Lying Quad Stretch Kneeling Rectus Femoris Stretch		2 x 20/sec 2 x 20/sec
5) Limited functional hamstring flexibility	n=16		n=14	Balance Stick Hamstring Kicks Toe Touch Progression		2 x 8 repetitions 2 x 10 repetitions 2 x 10 repetitions
6) Limited shoulder, scapular and thoracic spine mobility	n=16		n=13	Quadruped T-Spine Rotation		2 x 10 repetitions
7) Limited abdominal and trunk stability	n=8		n=13	Mountain Climber Shoulder Taps Shrimp		2 x 10 repetitions 2 x 10 repetitions

program was given to every subject of INT. A score of "one" or "zero" in any of the seven movements that compose the FMS as well as a "negative" TT or WBLT constituted a functional deficit. The exercises of the training programs were chosen by the researchers and aimed to improve the specific functional deficits of every subject (cf. table 2). The exercises were chosen from a catalogue of exercises, which is being used at the FC St. Pauli to improve functional deficits identified with the FMS. Every exercise in this catalogue corresponds to a specific movement of the FMS. Every participant was given six exercises including dynamic and static stretching exercises, strength exercises, exercises to improve stability of the musculoskeletal system and exercises to improve balance. Two sets of eight or ten repetitions were performed of all dynamic stretching exercises.

Exercises were demonstrated to the participants before the intervention. The training intervention was supervised by the trainers of the teams U11 and U13. CON did not change their warm-up, which consisted of jogging and running exercises. Both, INT and CON, completed their regular soccer practice three times per week for 90 minutes.

Statistical Analysis

All statistics were evaluated using SPSS 22 (IBM statistics Armonk, NY). To analyze differences between the groups for the pre-post conditions, variance (two-way ANOVA; group*time) was computed for each variable of the anthropometric data. A Wilcoxen-Test was conducted to describe functional deficits (i.e. FMS, TT, WLBT) in the pre-post condition. Group differences were calculated with

Table 2

Results of the pretest and posttest. Given are means and standard deviation. INT=intervention group; CON=control group; t1=pretest; t2=posttest; DS=Deep Squat; HS=Hurdle Step; ILL=In-Line Lunge; SM=Shoulder Mobility; ASLR=Active Straight Leg Raise; TSPU=Trunk Stability Push-Up; RS=Rotary Stability; TT=Toe Touch Test; WBLT=Weight-Bearing Lunge Test.

		DS	HS RIGHT	HS LEFT	ILL RIGHT	ILL LEFT	SM RIGHT	SM LEFT	ASLR RIGHT	ASLR LEFT	TSPU	RS RIGHT	RS LEFT	TOTAL SCORE	TT	WBLT RIGHT	WBLT LEFT
INT (n=23)	t1	1.65	1.78	1.74	1.78	1.87	2.57	2.35	2.04	1.91	2.26	1.87	1.87	13.26	0.39	0.26	0.26
		±0.49	±0.52	±0.45	±0.52	±0.54	±0.90	±0.95	±0.71	±0.67	±0.62	±0.34	±0.34	±1.84	±0.50	±0.45	±0.45
	t2	1.74	2.04	2.00	1.91	1.96	2.74	2.57	2.13	2.00	2.26	1.87	1.87	14.30	0.67	0.26	0.52
		±0.45	±0.21	±0.00	±0.42	±0.48	±0.45	±0.51	±0.63	±0.60	±0.62	±0.34	±0.34	±1.43	±0.47	±0.45	±0.51
CON (n=25)	t1	1.72	1.56	1.64	1.92	1.92	2.44	2.20	1.80	1.80	2.00	1.72	1.80	12.68	0.52	0.48	0.60
		±0.54	±0.65	±0.64	±0.57	±0.57	±0.82	±0.87	±0.65	±0.65	±0.87	±0.46	±0.41	±2.61	±0.51	±0.51	±0.50
	t2	1.72	1.60	1.76	1.92	2.00	2.52	2.36	1.84	1.80	2.04	1.72	1.80	13.16	0.52	0.48	0.60
		±0.54	±0.65	±0.60	±0.57	±0.50	±0.65	±0.64	±0.63	±0.65	±0.87	±0.46	±0.41	±2.44	±0.51	±0.51	±0.50

the Mann-Whitney-U-Test. Significance level was set as $\alpha=0.05$; normal distribution was tested using the Kolmogorow-Smirnow test. Effect sizes are given as partial eta squares (ηp^2). Bonferroni correction was applied to post hoc comparisons.

Results

Anthropometric Data of the Sample

All participants of the intervention and control group increased their body height ($F(1,46)=56.77$; $p<0.001$; $\eta p^2=0.55$) and body mass ($F(1,46)=11.55$; $p<0.01$; $\eta p^2=0.20$). As reported in table 1 the intervention group showed a greater growth (+1.56 cm) than the control group (+0.68 cm) from pre to post testing ($F(1,46)=7.77$; $p<0.01$; $\eta p^2=0.14$).

Functional Deficits of the Youth Athletes

Table 1 shows the functional deficits identified in INT and CON at the t1. In both groups limited hip and knee flexion and limited ankle dorsiflexion was observed most frequently. The difference between INT (n=8) and CON (n=13) was greatest concerning limited abdominal and trunk stability. Greater differences for the INT were observed for limited rectus femoris flexibility, limited functional hamstring flexibility and limited shoulder, scapular and thoracic spine mobility.

Effects of the Training Intervention on Motor Performance

As reported in table 2 all participants improved their performance; the changes in the different exercises are presented in table 2.

The Mann-Whitney-U-Test revealed significant group differences for the HS left and right at post-testing (left: $Z=-3.09$, $p=0.002$; right: $Z=-2.02$, $p=0.044$). Moreover, the WLBT differed between the groups at baseline testing ($Z=-2.34$, $p=0.019$). The Wilcoxen-Test showed significant improvements for both groups from pre- to post-testing (INT: $Z=-3.23$, $p=0.001$; CON: $Z=-2.97$, $p=0.003$). In addition, the intervention group improved in the HS left and right (left: $Z=-2.45$, $p=0.0012$; right: $Z=-2.45$, $p=0.001$), the TT ($Z=-2.47$; $p=0.008$) and the ankle mobility ($Z=-2.50$; $p=0.001$).

Discussion

The aim of this explorative study was to identify functional deficits in male child soccer players (aged 9 - 13 years) to implement injury prevention strategies into training sessions for soccer players under the age of 14 years.

Our hypothesis that male child soccer players already show functional deficits was verified; all participants of the study showed functional deficits in all observed variables (cf. Table 1).

These functional deficits are a risk for a variety of injuries like joint and ligament injuries, contusions, muscle and tendon injuries as well as fractures and bone injuries (27). Therefore, this study affirmatively confirms previous results highlighting reduced hip ROM and hamstring flexibility in professional soccer players aged 19-36 years (10). Imbalances between quadriceps and hamstring strength have been observed in youth soccer players aged 13 - 16 years (17). We hypothesized that because of adaptation to unilateral load in the absence of compensatory training these asymmetrical strength ratios can be already observed in soccer players aged 9 - 13 years. This hypothesis is supported by the data of the TT. Additionally, the functional deficits observed in this study were similar to those observed by Agre & Baxter (1), who identified deficient hip abduction, hip flexion, hip extension and ankle dorsiflexion in male collegiate soccer players. However, we recognize that sport-specific adaptations of the musculoskeletal system may also be beneficial and required for maximum performance.

Additionally, serious concerns remain regarding the validity and explanatory power of some of our results concerning the FMS. According to Kolodziej & Jaitner (2018), the risk of injury increases with a FMS score of lower than 14 while a lack of the trunk stability and rotary stability are the main predictors for injuries (20). However, as we examined children, the results of this paper might not be transferable into this age group. For our study, the limited ankle dorsiflexion and limited functional hamstring flexibility can be regarded as the key findings of this study, since those were also confirmed by the WBLT and TT. The training routine could reduce the functional and motor deficits in the posttest despite of limited exercise selection. Therefore, the results of this study demonstrate how little equipment and effort is needed to yield improvements and potentially › prevent sports injuries, as also shown by Imai et al. (18), who prevented injuries with three additional stability exercises in the warm-up program. When possible, stretching exercises were performed as dynamic stretching exercises, because it has been shown to increase flexibility and positively impact performance (5, 6, 22).

Because the multimodal training program is not time consuming it could easily be implemented into the warm-up phase of soccer practice twice a week for 10-15 minutes. The youth athletes executed the training intervention correctly, adhered to the program and effects were already seen after three months. However, future research needs to identify a minimum frequency per week and a minimum total duration.

The intervention group gained higher positive effects for the main outcome parameters of the FMS, the TT and the WBLT compared to the control group (cf. table 2). One might argue that the observed effects are a result of the increased body height (e.g. improvements of the Hurdle Step). However, the intervention group showed higher improvements for all tests in comparison to the control group, which underlines the benefits of the intervention. The results of the TT indicate improved flexibility of the hamstrings. Limited hamstring flexibility is associated with a higher risk of muscle strain, sprain or overuse injury (8, 30). However, research has not yet concluded why limited hamstring flexibility produces a higher risk of injury (8), but its injury-preventive effects are well documented. It is proposed that the mechanism for decreased range of motion in joints is a decreased neural stretch tolerance rather than a viscoelastic accommodation of the muscle-tendon unit (23). Bradley & Portas (8) suggest that some players with greater ROM may have a "flexibility reserve", which reduces tension on the hip and knee flexors during high speed movements such as sprinting, thus protecting these players against injury. The intervention was effective at increasing participants hamstring flexibility and thereby may reduce their risk of sports injury. The results of the WBLT indicate improved ankle dorsiflexion ROM in the study population. Greater ankle dorsiflexion ROM was associated with greater knee-flexion and smaller ground reaction forces during landing (15), which are both risk factors for anterior cruciate ligament injuries, indicating that increasing ankle dorsiflexion ROM may be an effective tool to reduce the risk of anterior cruciate ligament injuries (15). Additionally, poor ankle dorsiflexion ROM is a good indicator of ankle sprain (25). By increasing ankle dorsiflexion ROM in the intervention group, the intervention employed in this study may reduce participants risk of anterior cruciate ligament injury or ankle sprain.

In conclusion, we confirmed our hypothesis that a multimodal training intervention influences previously identified functional and motor deficits in soccer players aged 9-13 years.

Limitations

Due to practical reasons, a randomization of the subjects into an intervention and a control group was not possible. This may have led to a group bias in terms of age during a critical pubertal phase in favour of the intervention group, possibly confounding the results. The distribution followed in coordination with the coaching staff and investigators were not blinded to group allocation. The circumstances which caused the research to take place during the common practice might have led to the limitations of study design. Another limitation of the study is that the assessed functional and motor deficits are based on the judgement criteria of the researcher.

Conclusion

This study assessed a range of functional and motor deficits in male soccer players aged 9 - 13 years. In the population of this study, the intervention had positive effects on the previously assessed functional and motor deficits. To our best knowledge, this is the second study to investigate the effects of a multimodal training intervention in male soccer players under the age of 14 years. The additional benefit of this study results out of the fact that the multimodal training intervention used in this study employed different kinds of exercises than the first study did. Future research needs to assess the effects of such multimodal training interventions on the incidence of injury during practice and match to conduct effective injury prevention strategies for soccer players under the age of 14 years. Nonetheless, the results of this study lead to the recommendation to implement specific motor testing and individualized multimodal training programs into regular soccer practice of players under the age of 14 years.

Compliance with Ethical Guidelines

All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of Interest

The corresponding author and two of his co-authors declare that they have no competing interests. It is hereby declared that one of the co-authors of this study is part of the coaching staff of the FC St. Pauli.

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ERWEITERTES ABSTRACT

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Funktionelle und motorische Defizite bei Nachwuchsfußballspielern – eine explorative, quasi-experimentelle Studie

Functional and Motor Deficits in Youth Soccer Athletes – An Explorative, Quasi-Experimental Study

Design der Studie

In einem explorativen, quasi-experimentellen prä-post Studiendesign wurden N=48 Nachwuchsfußballer in eine Interventionsgruppe (INT, n=23) und eine Kontrollgruppe (CON, n=25) aufgeteilt. Nach der Identifikation motorischer Defizite, absolvierte INT eine individualisierte, multimodale Trainingsintervention.

Methoden

Testpersonen wurden in der Trainingsroutine (FC St.Pauli, Hamburg) rekrutiert und entlang der Mannschaftszugehörigkeit in INT (U11 & U13) und CON (U10 & U12) eingeteilt. Zur Identifikation funktioneller und motorischer Defizite dienten der Functional Movement Screen (FMS), der Toe Touch Test (TT) sowie der Weight-Bearing Lunge Test (WBLT). Die Personen der INT erhielten entsprechend der identifizierten funktionellen und motorischen Defizite ein individualisiertes, multimodales Trainingsprogramm bestehend aus sechs Übungen. Die Trainingsintervention dauerte zwölf Wochen und wurde für zehn bis 15 Minuten anstelle des regulären Aufwärmprograms ausgeführt.

Ergebnisse und Diskussion

Eingeschränkte Hüft- und Knieflexion sowie eingeschränkte Dorsalflexion im Sprunggelenk waren die häufigsten funktionellen und motorischen Defizite der Stichprobe. Die INT zeigte im Vergleich zur CON signifikante Verbesserungen in der Beweglichkeit der Beinbeugemuskulatur und der Dorsalflexion im Sprunggelenk. Durch die Verbesserung derselben beugt die hier implementierte Trainingsintervention möglicherweise Sportverletzungen vor und könnte das Verletzungsrisiko von Nachwuchsfußballern reduzieren. Dennoch erkennen die Autoren an, dass sportart-spezifische Anpassung des muskuloskelettalen Systems für maximale Performance vonnöten sein können.

Was ist neu und relevant?

Trotz umfangreichem, regelmäßigem Training lassen sich bereits in dieser Altersgruppe motorische Defizite erkennen, die jedoch mit regelmäßigem individualisiertem Training reduziert werden können.

Methodische Einschränkungen und Störfaktoren

Die Testpersonen konnten nicht randomisiert werden, sodass INT größer, schwerer und älter war. Ferner wurde die Erfassung der funktionellen oder motorischen Defizite von den Autoren dieser Studie selbst vorgenommen. Vorbehalte existieren im Hinblick auf die Gütekriterien des FMS.

Fazit für die Praxis

Bereits Nachwuchsfußballer im Alter von neun bis 13 Jahren weisen sportart-spezifische funktionelle und motorische Defizite auf. Diese Defizite lassen sich mit wenig Zeit- und Materialaufwand positiv beeinflussen. Im Sinne der Verletzungsprävention sollten auch in dieser Altersgruppe schon Testverfahren zur Identifikation funktioneller und motorischer Defizite in den Trainingsalltag integriert und individualisierte Trainingsinterventionen implementiert werden.