Dupuytren disease is highly prevalent in male field hockey players aged over 60 years

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Dupuytren disease in elderly male field hockey players

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ABSTRACT

BACKGROUND/AIM: Dupuytren disease (DD) is a fibroproliferative hand condition. The etiology has not been fully elucidated, and the role of exposure to vibration as risk factor has been studied with contradicting results. As field hockey is expected to be a strong source of hand-arm vibration, we hypothesized that long-term exposure to field hockey is associated with DD.

METHODS: In this cross-sectional cohort study, the hands of 169 male field hockey players (65-71 years old) and 156 male controls (59-71 years old) were examined for signs of DD. Details about their age, lifestyle factors, medical history, employment history and leisure activities were gathered. Prior to the analyses, the groups were balanced in risk factors using propensity score matching (PSM). The association between field hockey and DD was determined using a subject specific generalized linear mixed model with a binomial distribution and logit link function (matched pairs analysis).

RESULTS: DD was observed in 51.7% of the field hockey players, and in 13.8% of the controls. Field hockey playing as dichotomous variable after PSM was significantly associated with DD (OR = 9.42, 95% CI: 3.01 – 29.53), but a linear dose-response effect of field hockey (hours/week * years) within the field hockey players could not be demonstrated (OR = 1.03; 95% CI: 0.68 – 1.56).

DISCUSSION: These results suggest that field hockey only triggers the onset of DD, but has no influence on the course.

INTRODUCTION

Dupuytren disease (DD) is a chronic hand condition, that can result in contractures of the fingers, causing functional impairment. In this disease, fibroblasts of the palmar fascia transform into myofibroblasts, proliferate, deposit matrix and form nodules. Later on, cords are formed that may contract, causing flexion contractures of the fingers.(1) In the general elderly population, the prevalence of this disease ranges from 0.6 to 31.6%.(2)

Several intrinsic risk factors have been associated with DD, such as genes,(3,4) age,(5,6) and male gender.(6,7) In addition, numerous studies have been conducted reporting an association between DD and several extrinsic risk factors, such as alcohol consumption and vibration exposure.(8-10) Vibration exposure to the hands due to the handling of vibration tools for instance, can cause microtrauma and peripheral vascular changes.(11-13) These two mechanisms are suggested to be involved in the pathogenesis of DD.

In Europe, 14 to 34% of the workforce is occupationally exposed to vibration, mainly in the sectors of construction, manufacturing, mining, agriculture and fishing.(14) Hence, it can be expected that workers in these sectors show a higher prevalence of DD. However, studies concerning the relation between vibration exposure and DD provide varying results. Several studies did not show an association (15-18), while others even demonstrated a dose-response relation.(19) In the last decades, two literature reviews were conducted to elucidate the association between DD and vibration.(20,21) Liss and Stock (20) concluded that there is a strong indication for the presence of this association. Recently, a meta-analysis demonstrated that vibration was significantly associated with DD.(21) In both reviews it is suggested that several studies provide evidence for a dose-response relationship, but many included papers suffered from methodological flaws (e.g. unjustified corrections for factors that are no confounders, no physical examination to diagnose DD, inconsistencies in cross tabs possibly leading to an overestimated effect size).(10,19,22) So, the reviews are inconclusive and more directed research towards vibration is needed.

Most studies investigating this association take only the vibration exposure during work-related activities into account.(8-10,17,23) However, vibration exposure can also occur during leisure activities (e.g. sculpturing, do it yourself activities)(24) and sports (e.g. tennis, baseball, golf).(25-28) If vibration exposure during these kind of activities is associated with the presence of DD, this needs to be assessed when studying the influence of vibration to the occurrence of DD. There is only one previous paper that reports a high prevalence of DD in sportsmen.(29) However, this study focuses on the repetitive strain to the palmar fascia, and not on the vibration exposure.

Field hockey is expected to be a strong source of hand-arm vibration, which is generated as the stick hits the ball (or the ground). The vibrations are transferred from the stick to the hands and absorbed. Especially impacts that are not located on the sweet spot of the stick result in vibrations with large amplitudes, that can cause pain in the hands.(27) Field hockey can be considered as an elitist sport in the Netherlands, and the majority of the field hockey players are known to be white collar workers. Therefore, this population is suitable to investigate vibration exposure, since it is unlikely that the possible effect of vibration through hockey will be confounded by an effect of manual work. The aim of the current study is to determine whether field hockey is associated with the presence of DD in elderly male field hockey players. We hypothesize that this association is present, and that a dose-response relation exists.

METHODS

Design

The hypothesis was tested by a cross-sectional cohort study, including a group of field hockey players and a control group.

Participants

A sample size calculation was performed in G*Power, version 3.1.2 (30) using an odds ratio (OR) of 2.36 for vibration and manual work in association with DD (21) and a proportion of DD equal to 0.22.(5) To obtain a power of 80% for a two-sided test with the significance level at 5%, 74 participants were needed in each group (hockey players vs. controls) for a two-sample chi-square test.

The hockey players were recruited from a field hockey tournament for elderly male field hockey players, most of whom have played at a high level for a long period of time. The measurements took place during the tournament, so all 204 elderly male field hockey players who were registered for the tournament were asked to participate in this study. Data of 250 male controls from an age-stratified random sample of the general population of the Netherlands were used. These participants were previously included in a prevalence study,(5) and agreed to be approached again for further research. To control for the confounding effect of manual work, all manual workers were excluded, as well as all controls who were exposed to vibration during occupational, leisure or sports activities.

All participants gave a written informed consent. Due to the nature of this study, no approval of the medical ethics committee was needed.

Procedure

Prior to the start of the study, the board of the field hockey club was asked for permission to approach their members. After receiving permission, the field hockey players received an email with written information about this study and an informed consent form. On May 16th, 2013, the measurements took place during a tournament. Before the start of the tournament, the field hockey players were reminded of this study using a powerpoint presentation.

All participating field hockey players were interviewed about their employment history, leisure activities, lifestyle factors, health, and demographics. These interviews were conducted by employees of the department of Plastic Surgery, who received training beforehand on how to perform the interview. This was done to ensure that all participants were interviewed the same way. After the interview, the hands of the participants were examined for signs of DD by medical doctors (RL and PMNW) with broad experience in diagnosing DD.

The same data was collected from the controls. Diagnosis of DD in the control group was already determined using physical examination in the study of Lanting et al.(5), but controls were contacted again by telephone to collect detailed information about their employment history, leisure activities, lifestyle factors and other missing information.

Outcome measures

The primary outcome measure was the presence of DD in one or both hands, defined as nodules or cords with or without flexion contractures of the fingers.

The severity of the disease was a secondary outcome measure and determined using an adapted version of the Iselin classification (Figure 1).(31)

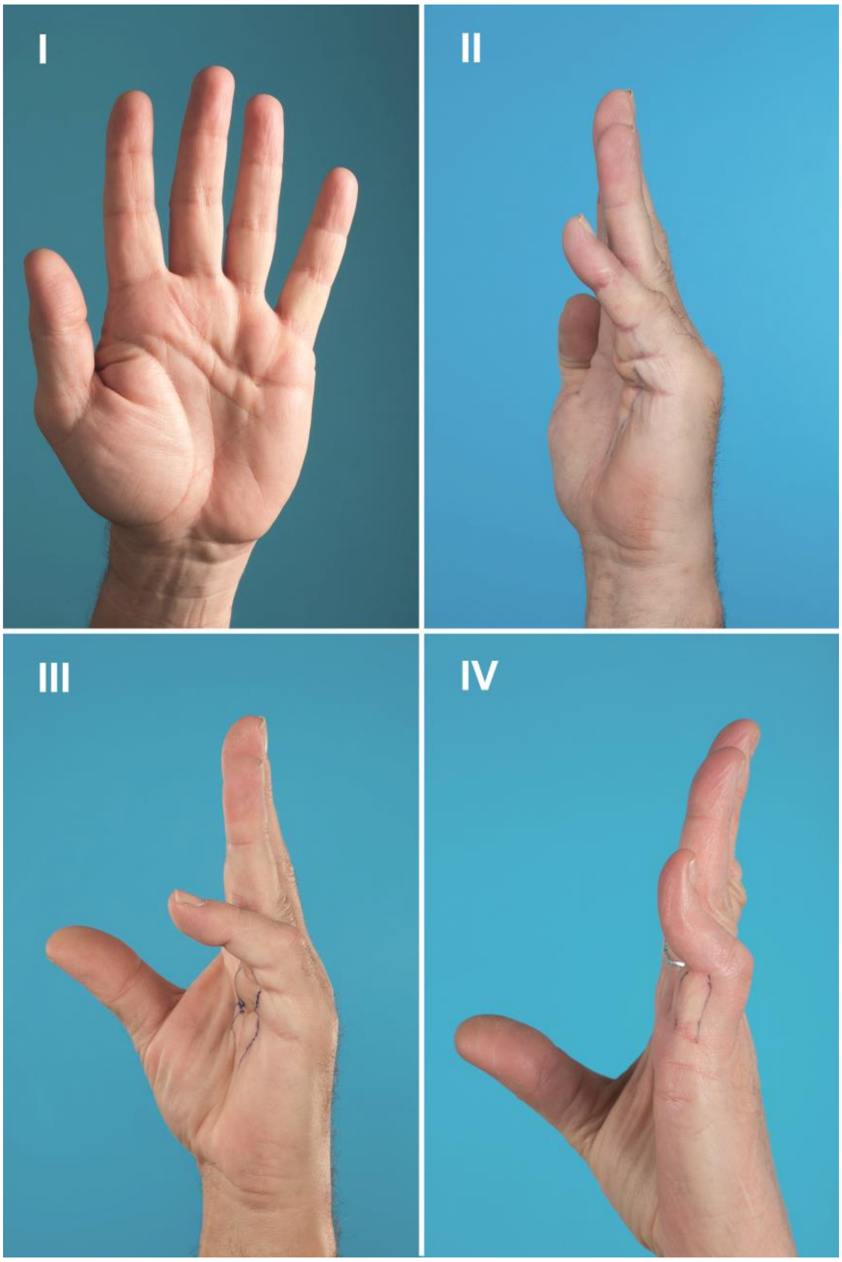

Figure 1. Iselin classification (adapted) indicating the different stages of Dupuytren disease.

Age, smoking habits, and alcohol consumption were collected as additional measures, including the amounts consumed represented by cigarettes, cigars or pipes per day or by glasses per week, respectively. All participants were also asked about their general health, including diabetes, epilepsy, and whether they had sustained hand injuries in the past. The hockey players were asked about the intensity (hours/week) and duration (years) of the field hockey, during their life.

Statistical analyses

Descriptive statistics were presented by frequencies and percentages for nominal and ordinal data. For data at interval or ratio level, descriptives were presented by medians and interquartile ranges (IQR). Differences between the hockey players and controls were determined by the Fisher's exact test for nominal and ordinal data, and by the Mann-Whitney U test for data at interval or ratio level.

Since the two groups were expected to be significantly different on various characteristics, propensity score matching was used to balance the groups.(32) A propensity score can be considered as an a priori probability of a participant to be included in the experimental group, in this case the field hockey group, given a set of characteristics. By matching the participants based on the propensity score, we matched field hockey players with controls having the same likelihood to be part of the hockey group. The propensity score was calculated using a logistic regression model based on the variables age, diabetes, smoking, alcohol consumption and familial presence of DD.(33-35) Epilepsy was not included, since only one participant suffered from this disease.

Then, propensity score matching with replacement was done,(36) with exact match priority. A caliper of 0.2 SD of the logit score was used as tolerance level for matching.(37) When multiple controls were equally eligible to be matched to a field hockey player, the participant to be matched was chosen randomly. To determine whether the matching procedure successfully balanced the two groups in descriptive characteristics, the same statistical comparison between field hockey players and controls were done as mentioned in the paragraph above.

A subject specific generalized linear mixed model was fitted to determine the effect of field hockey as dichotomous variable on the proportion of DD. A Bernoulli distribution with a logit link function was used. Hockey (yes/no) was entered as fixed effect, and a random effect was entered for matched pairs to control for the correlated observations (which is a result of the matching procedure).

Then, to examine the presence of a dose-response relation, logistic regression was applied within the field hockey group of the original (non-matched) database, with field hockey entered as continuous variable. This variable was standardized to the absolute number of weeks that a participants had played ((hrs / week * yrs) / 168). Age was included in the model to account for its potential confounding effect. Additionally, an ordinal logistic regression analysis was done to determine the effect of field hockey on the severity of the disease, defined by the Iselin stage. A sensitivity analysis was done to gain more insight in the effect of field hockey on the presence of DD.

The propensity matching procedure was performed in SPSS version 23, as well as the statistical analyses. Missing values were excluded listwise from the analyses, and a significance level of 5% was used.

RESULTS

A total of 325 subjects participated in this study. Among the field hockey players, 169 of the 204 hockey players who were asked for participation, agreed to participate (83%). In the control group this was 156 of the 247 (63%). Three of the 91 non-participating controls replied that they refused to participate, the other 88 did not respond. Manual workers and controls exposed to vibration were excluded (Figure 2). The propensity score matching procedure yielded 42 pairs, so the data of 84 participants in total were used in the analyses.

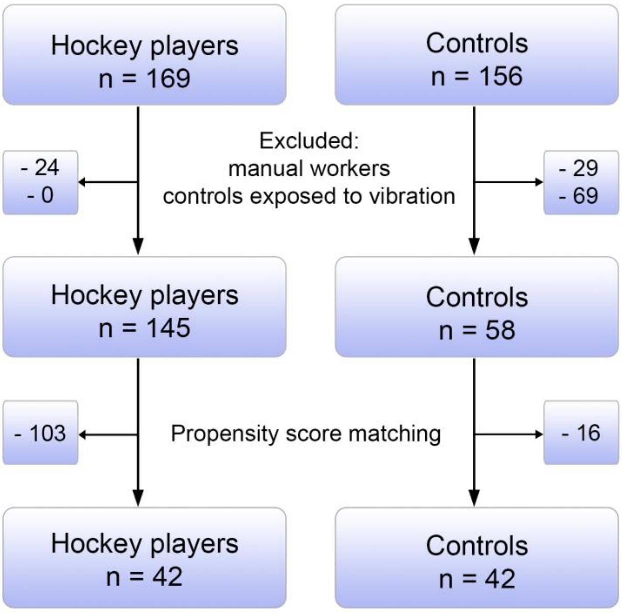

Figure 2. Schematic representation of the inclusion an exclusion procedure of participants.

Table 1 shows the descriptive statistics of the field hockey players and the controls before and after the propensity score matching. Before matching, there were significant differences between the two groups with respect to age and smoking habits. After the matching, differences in characteristics reduced or vanished.

Table 1. Characteristics of the field hockey players and the controls before and after the propensity score matching procedure.

	Before propensity score matching			**After propensity score matching**		
	Hockey players (n = 145)	**Controls (n = 58)**	**p-value**	**Hockey players (n = 42)**	**Controls (n = 42)**	**p-value**
Age in years (median)	67.0	61.5	*.001*[a]	66.0	62.5	0.122[a]
IQR	65.0 – 71.0	58.3 – 68.3		(62.0 – 69.3)	(59.0 – 71.0)	
Missing (n)	3	0		0	0	
Alcohol consumption in units/week (median)	10.0	5.0	.166 [a]	8.5	6.50	0.603[a]
IQR	5.0 – 20.0	0.2 – 11.3		(3.8 – 14.0)	(2.0 – 14.0)	
Missing (n)	3	0		0	0	
Smoking in pack years (median)	2.5	6.4	*.001*[a]	3.0	0.0	0.334[a]
IQR	0.0 – 13.0	0.0 – 23.0		(0.0 – 15.0)	(0.0 – 11.2)	
Missing (n)	3	0		0	0	
Diabetes (n)	11 (7.6%)	5 (8.6%)	.779[b]	4 (9.5%)	3 (7.1%)	1.000[b]
Missing (n)	0	0		0	0	
Epilepsy (n)	0 (0.0%)	1 (1.7%)	.286[b]	0 (0.0%)	0 (0.0%)	-
Missing (n)	0	0		0	0	

[a] Mann-Whitney U test; [b] Fisher's exact test, IQR = Interquartile range

In Table 2 the proportion of DD in the two groups is presented, as well as the severity of the disease. DD was almost 4 times more prevalent in the field hockey group compared to the controls. In both groups, mild disease (i.e. nodules in absence of contractures) was the most common disease presentation. Only a few participants in both groups showed DD with flexion contractures of the finger(s).

Table 2. Proportion of Dupuytren cases and disease severity in the field hockey group compared to the control group.

	Hockey players (n = 145)	**Controls (n = 58)**
Dupuytren (n)	75 (51.7%)	8 (13.8%)
Missing (n)	0	0
Iselin stage (n)		
1	63 (43.4%)	5 (8.6%)
2	5 (3.4%)	1 (1.7%)
3	6 (4.1%)	2 (3.4%)
4	1 (0.7%)	0 (0.0%)
Missing (n)	0	0

To visualize the proportion DD with respect to the amount of field hockey exposure, we plotted the logit of the proportion DD against different groups of field hockey exposure (Figure 3). It can be seen that the logit of the proportion DD was much lower in the control group compared to the field hockey players.

The results of the generalized linear mixed model after propensity score matching indeed show that field hockey playing as dichotomous variable was significantly associated with the presence of DD (OR = 9.42; 95% CI: 3.01 – 29.53).

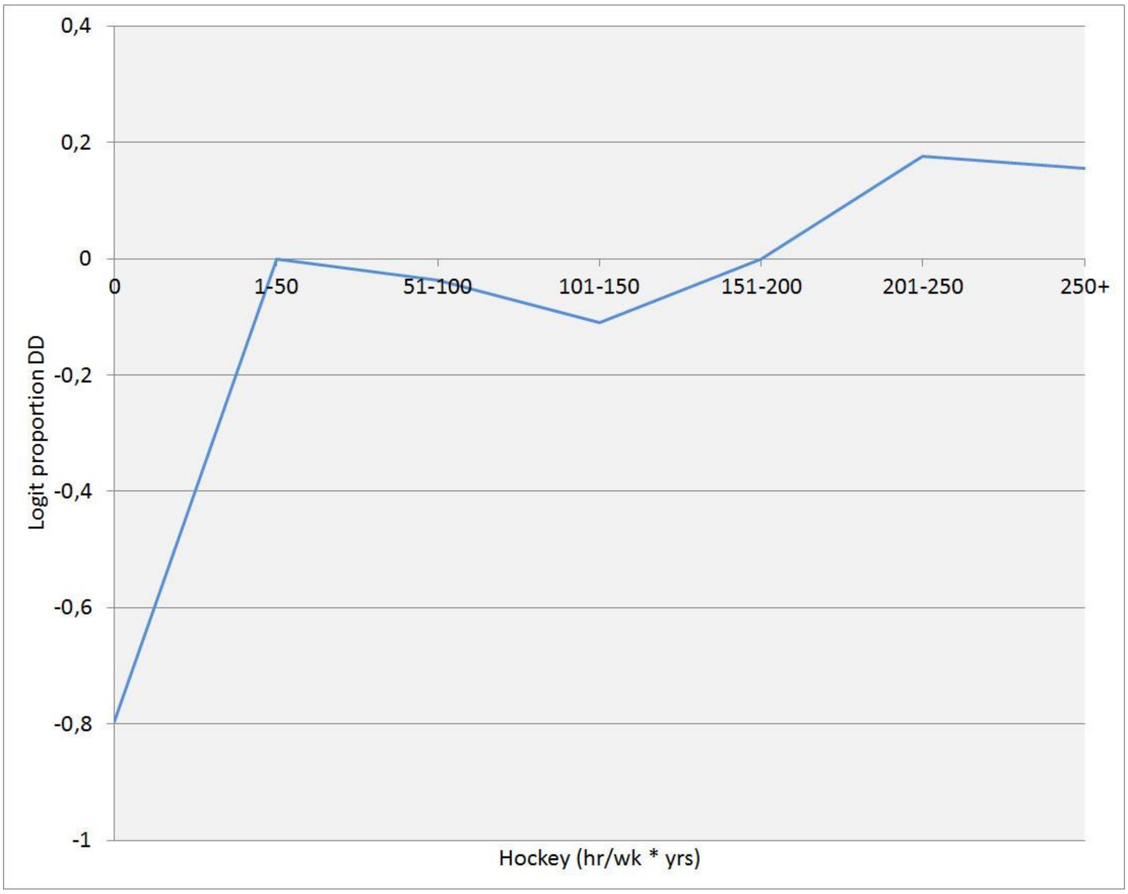

Figure 3. The effect of field hockey on the logit of the proportion of DD.

Within the field hockey group, Figure 3 demonstrates that the highly exposed groups had a higher logit of the proportion DD than the lower exposed groups. This indicates the possibility of a dose-response relation. However, applying logistic regression within the field hockey group showed that field hockey as continuous variable (expressed as (hrs/wk * yrs)/168), corrected for age, did not demonstrate a significant dose-response relation with DD (OR = 1.03; 95% CI: 0.68 – 1.56). The same result was found when the disease severity (Iselin stage) was used as outcome variable (OR = 1.00; 95% CI: 0.67 – 1.49).

A sensitivity analysis was done to determine if the choice of the model (linear profile for field hockey and the log odds for DD) would affect the conclusion.

Two additional analyses were provided. We tried different cut-off points for the amount of field hockey to see if field hockey beyond the cut-off point would entail a higher proportion of DD. The optimal cut-off point was determined at 217 hrs/wk * yrs, and provided a p-value of 0.059. The second analysis tested a shift in distribution of field hockey between participants with and without DD using a Mann-Whitney U test ($p = 0.433$). Both analyses did not demonstrate a dose-response relation either.

DISCUSSION

The aim of this study was to determine whether exposure to life-long field hockey playing was associated with the presence of DD. We hypothesized that (micro)trauma might be responsible for a higher prevalence of DD in field hockey players compared with controls, even with presence of a dose-response relation, since field hockey is expected to be a strong source of hand-arm vibration. Hand-arm vibration is associated with microtrauma and peripheral changes, that might trigger the pathogenesis of DD.(11-13)

After propensity score matching, the results show that field hockey has a strong association with DD which supports previous findings.(8-10) However, a continuous dose-response relation within the field hockey group was not found. This seems to be in contrast to several other studies that report to have found a linear dose-response relation between vibration and DD.(8,19,22)

There are several possible explanations that may account for this discrepancy. One reason is that previous reported studies may have overestimated the effect due to methodological issues, e.g. no physical examination to diagnose DD, or inconsistencies in cross tabs possibly resulting in an incorrect OR calculation.(8,22)

Further, we drew our sample among elderly field hockey players that were still playing. Therefore, severe cases of Dupuytren with large hockey exposure might not have entered our sample due to the sampling procedure, as patients with severe disease would not be able to play anymore.

Another possibility is that hand injury, that might result from playing field hockey, contributes to the larger proportion of Dupuytren disease in the field hockey group, but not to a dose-response relation. Hand injury has previously been associated with DD,(5,38-40) and field hockey players might have a higher probability of injury as a consequence of the sport. We did inquire about hand injury to address this, but most participants had difficulties to remember the type of injury, and which hand or finger was injured. Thus we could not evaluate this hypothesis any further.

The results of this study suggest that the onset of DD is only triggered by playing field hockey, and that it does not influence the disease course. One theory is that microtrauma (that might occur during field hockey playing) triggers the Wnt-signaling pathway, which is involved in cell proliferation and differentiation.(41) By activating this pathway, proliferation of fibroblasts occurs. This theory is supported by the findings that the anomalies in DD tissue resemble the early stages of wound repair.(40,42) This would support our findings of an effect of field hockey with the absence of a dose-response relation.

The strength of this study is that all the participants were physically examined by medical doctors experienced in diagnosing DD. This guaranteed the reliability of our observations. Another strength is the use of propensity score matching. In observational studies like this, randomization is not possible. Therefore, several sources of bias are introduced that can result in incorrect conclusions.(32) After matching, the differences between the two groups were reduced or vanished, indicating that the propensity score matching provided a more balanced view on the characteristics between the field hockey players and controls. Additionally, by excluding all manual workers, we had a relatively homogeneous group of participants who were all exposed to vibration in the same way. This further extends the reliability of our results. Finally, using a sensitivity analysis, we tested whether we chose the correct model to evaluate the association. This was not significant, so we can assure that there is no dose-response relation between field hockey and the presence of DD in our sample.

There are several limitations in our study. First, recall bias has probably played a large role in our study, since many variables were gathered using an interview. Unfortunately, there are no other alternatives to determine, for instance, the life-time exposure to vibration as in field hockey.

Second, the sample size calculation showed that we had to include 74 participants in each group, while we had 42 participants in each group after matching. However, this sample size calculation was done for a two-sample Chi-square test and not for matched samples. The propensity score matching increased our effect size compared to an analysis without correction.

At last, we probably missed severe cases due to the sample selection, since hockey players with severe DD may not be able to play anymore. Missing severe cases has probably resulted in an underestimation of the effect size in our sample.

In conclusion, the results of this study show that field hockey playing has a strong association with the presence of DD. A linear dose-response relation between field hockey and DD was not found within the field hockey group, suggesting that field hockey only triggers the onset of DD.

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COMPETING INTERESTS

The authors have no completing interests to declare.

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WHAT ARE THE NEW FINDINGS

- Field hockey is strongly associated with Dupuytren disease
- No dose-response relation was found
- Field hockey seems to trigger the onset of Dupuytren disease, but has no influence on the course

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