

ORIGINAL ARTICLE
SPORT INJURIES AND REHABILITATIONHigh incidence of hip and knee arthroplasty
in former professional, male football playersPiero VOLPI ^{1,2,3}, Alessandro QUAGLIA ^{1,2}, Giulia CARIMATI ^{1,2},
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ABSTRACT

BACKGROUND: The purpose of this study was to estimate the incidence of hip and knee arthroplasty in Italian male professional football (soccer) players who have played for a minimum 10 years in the Italian major football leagues.**METHODS:** The study group was formed by 104 male professional football players who were interviewed to evaluate the incidence of hip and knee arthroplasty. The data were collected through a questionnaire and the results collected were compared with a control group of 100 volunteers matched for age, weight and height, who did not present orthopedic diseases but had never practiced sport.**RESULTS:** In the study group, 26 subjects (25%) underwent hip and knee arthroplasty at an average mean age of 62.1±6 years. The frequency of arthroplasty was: 13.5% for the hip, 5.8% for the knee and 5.8% for both hip and knee. In the control group, the incidence of arthroplasty was 1% for the knee and no subjects presented hip arthroplasty.**CONCLUSIONS:** Italian male, former professional football players present a higher than normal incidence of hip and knee arthroplasty. Further studies are necessary to understand the pathological pathways underlying the etiology of hip and knee osteoarthritis in male populations of former professional football players in order to develop effective preventive programs to reduce the percentage of arthroplasties.*(Cite this article as: Volpi P, Quaglia A, Carimati G, Petrillo S, Bisciotti GN. High incidence of hip and knee arthroplasty in former professional, male football players. J Sports Med Phys Fitness 2019;59:000–000. DOI: 10.23736/S0022-4707.18.08962-4)***KEY WORDS:** Athletic injuries; Soccer; Osteoarthritis; Knee replacement arthroplasty; Hip replacement arthroplasty.

Football is currently played by over 265 million individuals of which approximately 200,000 are professional football players (PFP) with an additional 38 million players engaged in competitive football leagues. The total number of football players is almost 10% greater than that recorded six years ago.^{1,2} A professional career in football typically lasts an average of 13.5 years^{1,3,4} during which period, the PFP are exposed to intensive training and short recovery times, strenuous training loads and repetitive rotational motions that lead to intense physical stress. This intense physical stress causes an equally important biomechanical overuse of joint cartilages in the lower limbs, especially of the knee and hip joints.⁵⁻⁷ It has been proven

that overuse injuries, caused by intense athletic activity in PFP, lead to premature cartilage degeneration with an early onset of osteoarthritis of the lower limbs (OA).⁸⁻¹¹

In PFP, 17% of all injuries involve the knee³ whereas the hip joint shows a high incidence of Cam deformity, Pincer femoroacetabular impingement (FAI) and acetalubar labrum tears.¹² These data support the high predisposition of PFP to prematurely developing arthritis of the knee and hip.¹¹ Indeed, clinical OA of the lower limbs (both hip and knee) was detected in 32-49% of former professional football players (FPFP) while radiographic OA were present in 60-80% of cases.^{7,11} A recent systematic review shows that in PFP populations, clinical and

radiographic hip OA are present respectively in 8.6% and 21.2% of players, while clinical and radiographic knee OA is present respectively in 14.6% and 53.7% of players.¹¹ These data suggest a high incidence of early OA in FFPF in at least one of the lower limb joints, which is significantly greater than that of the general population.^{7, 11, 13} A severe degree of OS in the lower limbs is often followed by hip or knee arthroplasty¹⁴ and a subsequent reduction in the quality of life. Given the popularity of football, the premature onset of arthritis in FFPF and the subsequent need for joint replacement surgery risks becoming a problem of growing proportions. The purpose of this study was to estimate the incidence of hip and knee arthroplasties in FFPF who have played in professional Italian football leagues (Serie A and/or Serie B) for at least 10 years.

Materials and methods

Study design

The present retrospective comparative study was performed in 2016, from January to December. The FFPF included in the study were recruited *via* the “Senior Department” of the Italian Association of Football Players (*Associazione Italiana Calciatori*, AIC). The study included a study group (SG) and a control group (CG). The SG consisted of 157 Italian male FFPF who had played in the Serie A and/or Serie B leagues for a minimum of 10 years. They were contacted telephonically by the AIC Senior department to answer a tailored version of the WOMAC questionnaire. The CG was made up of 100 Italian sedentary male subjects. Each subject met the eligibility criteria for inclusion in the study. Approval from the Ethical Committee was granted and written consent from each participant was obtained. The STROBE statement,¹⁵ supplemented by the TIDieR checklist and guide,^{16, 17} was consulted for the study design.

Setting

Each volunteer participating in the study was contacted by phone and invited to answer a modified version of the WOMAC survey, tailored especially for evaluating the incidence of hip and knee arthroplasties¹⁸ in this cohort of SG patients. Moreover, the following data were collected:

- personal data (age, weight, height);
- age of the patient at the time of prosthetic implant (if present);
- duration of professional football activity;

- dominant leg;
- knee and/or hip operations prior to the study such as ACL reconstruction, meniscectomy and acetabular labrum reconstruction respectively.

The primary purpose of the survey carried out on the CG group was to evaluate the incidence of hip and knee arthroplasties in this cohort of patients. Moreover, the following variables were collected:

- personal data (age, weight, height);
- age of the patient at the time of arthroplasty implantation (if present);
- knee and/or hip operations prior to the study such as ACL reconstruction, meniscectomy and acetabular labrum reconstruction respectively.

Eligibility criteria

The inclusion criteria adopted for the SG ensured that the study only included subjects who were male FFPF aged ≥ 60 years, who had played for at least 10 years in Italian Football Leagues (Serie A and/or Serie B). The exclusion criteria included subjects who still practiced football, even if at a lower level, or were incapable of completing the survey because of language problems or cognitive disease. The inclusion criteria adopted for the CG ensured that the study only included sedentary subjects who had never participated in competitive sporting activities and/or never carried out physically arduous jobs.⁸ The exclusion criteria included subjects who were incapable of completing the survey because of language problems or cognitive disease. The CG was made up of volunteers who matched the SG group for gender, age weight and height.

Participants

According to the eligibility criteria of the SG stated above, two people were excluded because they were not compliant with the inclusion-exclusion criteria due to terminal amyotrophic lateral sclerosis and language problems. Another 51 patients decided not to participate in the study. The remaining 104 people were enrolled in the SG.

Demographic data

The following demographic data were recorded for both the SG and the CG: age, height, body weight. The age, height and body weight of the SG subjects were 69.70 ± 3.20 years, 177.60 ± 5.32 cm and 79.21 ± 9.12 kg, respectively. The age, height and body weight for the subjects enrolled in the CG were 69.47 ± 2.95 years, 176.68 ± 6.0 cm and 79.88 ± 10.69 kg, respectively.

For both the SG and the CG, the data concerning weight and high were used to calculate the Body Mass Index (BMI).¹⁹

Statistical analysis

Quantitative variables were reported as mean averages and the standard deviation and qualitative variables were displayed as percentages and absolute frequencies.

The homogeneity between the data of age, height and body weight of the subjects belonging to the SG and CG were verified by an unpaired two-sample *t*-test.

A Fisher's exact test was used for the following:

- to determine whether the distributions of the variables for hip and knee arthroplasties in the SG and the CG were statistically different;
- to determine whether there was a statistical difference in the distributions of the variables for hip and knee arthroplasties within the SG;
- to determine whether the distributions of the variables defining arthroplasty in the dominant leg, the non-dominant leg and in both the dominant and non-dominant leg, were statistically different within the SG.

The statistical difference between the age of the subjects in the SG at the time of arthroplastic implantation and that of the normal population present in literature was verified by an unpaired two-sample *t*-test. The statistical difference between the BMI of the subjects in the SG and in the CG was verified by an unpaired two-sample *t*-test. The statistical significance was set at $P < 0.05$. Data analyses were performed using SPSS v. 18.0.

Results

In the SG, the duration of professional football activity was equal to 15.31 ± 3.52 years (range 10-20). The results are as follows:

- 14 (13.5%) subjects underwent hip arthroplasty *versus* none in the CG;
- 6 (5.8%) subjects underwent knee arthroplasty *versus* 1 (1%) subject in the CG ($P < 0.001$);
- 6 (5.8%) subjects underwent both hip and knee arthroplasty *versus* none in the CG;
- 3 (2.9%) subjects underwent arthroplasty in the dominant leg;
- 9 (8.6%) subjects underwent arthroplasty in the non-dominant leg;
- 14 (13.5%) subjects underwent arthroplasty in both the dominant and the non-dominant leg.

Eight subjects from the SG (7.7%) and nine subjects

TABLE I.—Results of the Fisher's exact test concerning the prevalence of arthroplasties in dominant leg, non-dominant leg and in both dominant and non-dominant leg in the subject belonging from SG.

Parameter	Dominant leg	Non-dominant leg	Both
Dominant leg	—	$P < 0.005$	$P < 0.001$
Non-dominant leg	$P < 0.005$	—	NS
Both	$P < 0.001$	NS	—

NS: not statistically significant difference.

from the CG (9%) underwent ACL reconstruction and/or meniscectomy. This difference was not statistically significant. Acetabular labrum reconstruction was not carried out in either of the groups.

The Fisher's exact test results for the SG, regarding the occurrence of arthroplasty in the dominant leg, the non-dominant leg and in both legs are shown in Table I. In the SG, the age of the subjects at the time of arthroplastic implantation was 62.30 ± 2.10 years. The BMIs of the SG and CG were 25.11 ± 2.55 and 25.59 ± 2.60 respectively but the difference was not statistically significant.

The results are shown graphically in Figures 1, 2, 3, 4.

Discussion

The main finding in this study is the high incidence of hip and knee arthroplasties in Italian FFPF in comparison to the sedentary population. The numerical findings of this study are higher than those reported by Tveit *et al.*,²⁰ who recorded hip and knee arthroplasties in 368 male FFPF, with an average age of 62.8 years, to be 8.7% and 3.3% respectively. On the other hand, there was a lower occurrence of knee arthroplasty in this study than in that carried out by Fernandes *et al.*²¹ where 1207 FFPF were studied,

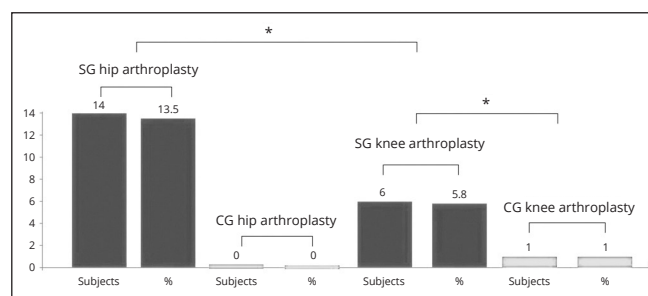


Figure 1.—Occurrence of hip and knee arthroplasty in the study and control groups. In the SG, 14 (13.5%) of the population underwent hip arthroplasty whereas no such cases were reported in the CG. Six (5.8%) cases of knee arthroplasty were recorded in the SG yet only one (1%) in the CG.

* $P < 0.001$.

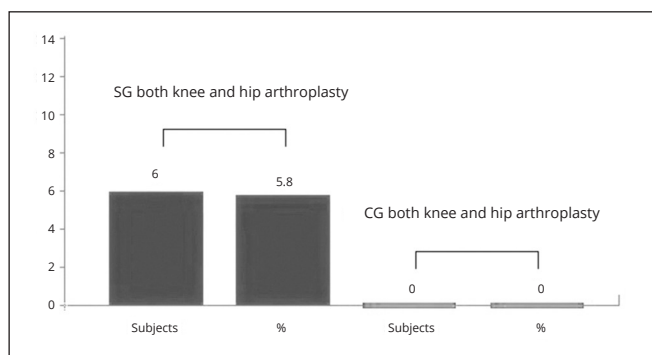


Figure 2.—Double arthroplasty of the hip and knee in the study and control groups. In the SG, six people (5.8%) underwent a double arthroplasty of the knee and hip. No such cases were reported in the GC.

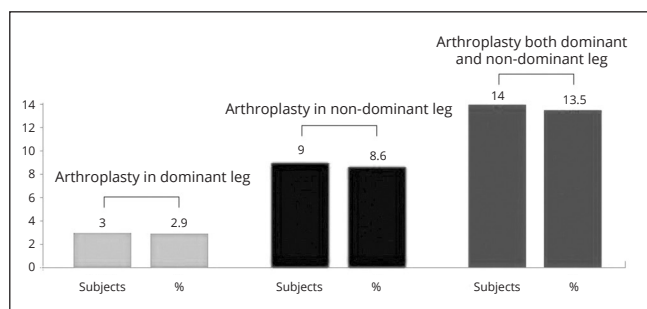


Figure 3.—Type of arthroplasty present in the study group SG. Three people (2.9%) underwent arthroplasty of the dominant leg, nine people (8.6%) underwent replacement of the non-dominant leg and 14 people (13.5%) underwent an arthroplasty of both limbs (double arthroplasty).

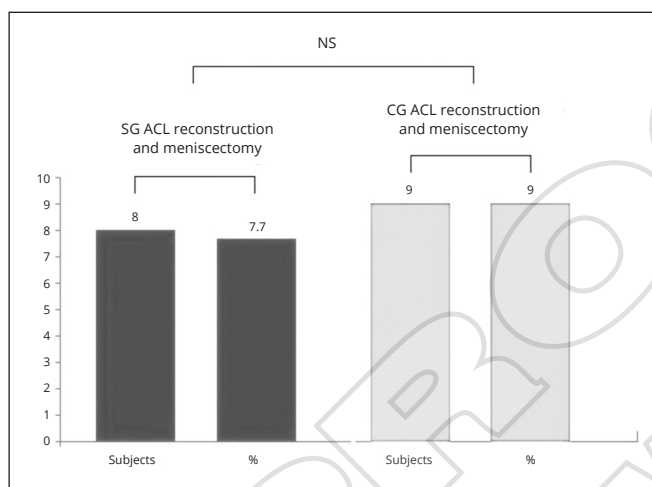


Figure 4.—Number and percentage of people belonging to the study and control groups who had been subjected to ACL reconstruction and/or meniscectomy. NS: not statistically significant difference.

and knee arthroplasties were found to afflict 11.1% of the population. This discrepancy may be explained by the difference between the populations taken into consideration. Indeed, Tveit *et al.*²⁰ do not specify the level of competition of the football players considered; whilst Fernandes *et al.*²¹ considered a population of English FFPF, we considered a population of Italian FFPF. The difference that exists between training loads in English and Italian football could, at least in part, explain the difference between the two studies.²² Nonetheless, the findings of this study are in line with those of previous studies:²⁰ as expected, the incidence of hip and knee arthroplasties was significantly higher in former professional athletes than in sedentary populations. The higher incidence of hip and knee arthro-

plasties may be explained by the fact that during football, the hip and knee joints are subjected to considerable mechanical loads and repetitive torsional motions; together these cause substantial overuse which, in turn, can lead to the onset of early OS.²¹

Furthermore, when football is practiced from a young age, it can produce a non-physiological closure of the femoral epiphysis, leading to anatomical abnormalities of both the femoral head-knee junction and acetabulum (Cam and Pincer FAI), and the onset of early OS.²³⁻²⁵ Within the SG of this study, the higher incidence of hip arthroplasties in comparison to knee- arthroplasties ($P < 0.001$) may be accounted for by the high incidence of Cam deformities displayed by the FFPF population.²³⁻²⁵ Furthermore, it is important to remember that the significant presence of anterior cruciate ligament reconstruction and meniscectomy in FFPF, both of which are a common consequence of knee sprains, is related to an early onset of knee OA respectively in 50% and 92% of cases.^{26, 27} In this context, it is interesting to note that Tveit *et al.*²⁰ showed how previous knee injuries are related to OA in a FFPF population. Moreover, Iosifidis *et al.*²⁸ reported that when patients with a history of lower limb trauma were excluded, the occurrence of OA in the FFPF population and in the sedentary control population was statistically the same.

The percentage of people who had undergone ACL reconstruction and/or meniscectomy in the two groups, was statistically non-significant. Acetabular labrum reconstruction was not encountered in either of the groups. Our results indicate that any prior injuries to the hip or knee are not linked to the need for arthroplasty implantation. However, as already mentioned, due to the relatively small test groups employed, we cannot put forth any conclusive hypotheses. Therefore, additional, statistically more sig-

nificant studies are required for an in-depth study of the correlation between earlier traumas to the knee and hip, and the necessity for arthroplasty implantation.

The data recorded in this study, compared to previous studies,^{7, 21} showed a higher incidence of arthroplasty in the non-dominant leg in comparison to the dominant leg. It is important to remember that in football, the non-dominant leg is the support leg while the dominant leg is the leg with which the football player kicks the ball. Such a marked incidence may be attributed to a particular and frequent movement carried out by players that can result in cartilage damage,⁷ namely pivoting on the non-dominant leg during rotational movements in weight bearing situations.

There are many risk factors for the development of OA and the need for consequent arthroplastic implantation among which increased BMI is the most common.¹⁴ An important number of FFPF, in no longer practicing sport and in adopting a sedentary lifestyle, increase their BMI and thus the risk factors for developing OA²¹ increase. A BMI value between 25 and 30 corresponds to an index of being "over-weight"¹⁹. In this study, the BMI of the SG and the CG were 25.11 ± 2.55 and 25.59 ± 2.60 respectively. The statistical difference was not significant. For this reason, being overweight may be one of the reasons, although not the most important reason, for the higher incidence of hip and knee arthroplasty in the SG compared to the CG. Indeed, it is very probable that the most important risk factor for hip and knee arthroplastic implantation is the high level of sporting activities performed by the subjects belonging to the SG in comparison to the subjects belonging to the CG.^{14, 20, 21, 29-31} Moreover, the BMI of the volunteers was calculated at the time of the study, and most probably does not correspond to the BMI that these players possessed during their sporting career. Therefore, based on the results from our study, we cannot postulate that the BMI displayed by the players during their career had any influence on the onset of overuse disorders of the hip and/or knee. Therefore, in order to formulate valid hypotheses on the effect of BMI on overuse pathologies, additional, long-term studies are necessary which monitor the athlete's BMI throughout his career.

The SG subjects underwent a hip and /or knee arthroplasty at the age of 62.30 ± 2.10 years. These findings do not differ from the data present in other studies³² concerning the age at which a sedentary population undergoes hip and/or knee arthroplasty (*i.e.* 66.32 ± 2.36 years). Based on this data, the population of FFPF, considered in this study, would seem to be more at risk for hip and knee arthroplas-

tic implantation than the sedentary population of the CG but, this does not seem to occur at an earlier age. Finally, these and similar findings,²¹ would justify the recognition of hip and knee OA, and consequently hip and knee arthroplasty, as an occupational disease for FFPF.

Strengths, limitations and future perspectives of the study

The major strength of the present study is that it is the first line of research conducted on a population of Italian FFPF dealing with the incidence of hip and knee arthroplasty.

Limitations of this study are represented by the size of the examined sample groups. Indeed, in putting forth the hypothesis that FFPF represent a population with a greater risk for hip and knee arthroplasty and in assuming a value of 80% at 0.05 and a relative risk of 2.0, the sample size required to demonstrate this hypothesis is 424 participants per group.²¹

We hope that future research will be able to implement statistically significant studies to examine, in depth, the important relationship between earlier injuries to the hip and knee joints, and arthroplastic implantation.

Conclusions

Severe OA and consequently hip and knee arthroplasty cause a sharp decrease in the quality of life. This study shows a higher incidence of hip and knee arthroplasty in a FFPF in comparison to a control group composed of sedentary subjects. Based on these data, it is very important to discuss and examine the correlation between the participation in professional football and the development of severe OA necessitating arthroplasty. Furthermore, it is of paramount importance to try to implement a prevention program to support PFP and FFPF to minimize this problem.

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