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FMUP FACULDADE DE MEDICINA UNIVERSIDADE DO PORTO

MESTRADO INTEGRADO EM MEDICINA

2017/2018

Matilde Martins Cardoso de Oliveira Pinto

Young European Elite Female Basketball Players' Injuries and Training Characterization

março, 2018

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Mestrado Integrado em Medicina

Área: Medicina Clínica

Tipologia: Dissertação

Trabalho efetuado sob a Orientação de:

Prof. Doutor João Torres

Trabalho organizado de acordo com as normas da revista:

American Journal Of Sports Medicine

março, 2018

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Medicina Clínica

TÍTULO DISSERTAÇÃO

Young European Elite Female Basketball Players' Injuries and Training Characterization

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Prof. Doutor João Torres

COORIENTADOR (se aplicável)

-

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Faculdade de Medicina da Universidade do Porto, 14/03/2018

Assinatura conforme cartão de identificação: Matilde Oliveira Pinto

Young European Elite Female Basketball Players' Injuries and Training Characterization

Abstract

Background: Basketball has a high injury rate especially in women. Studies show that the most commonly injured body region is the lower limb and ankle sprains are the most common diagnosis.

Purpose: The aim of this study was to investigate the frequency of overall injuries and associated risk factors among young European female elite basketball players, while also characterizing their training habits.

Study Design: Cross-sectional retrospective study.

Methods: Were invited to participate in the study 16 basketball teams that were participating at the FIBA U20 Women's European Championship in 2017. All information was collected through a questionnaire. 6 teams declined to participate, so data was collected from 10 teams. 16 players didn’t fill the questionnaire, leading to a total of 105 players participating.

Results: 77,1% of the athletes sustained at least one injury during their playing experience and 13,3% of them had multiple injuries. Ligaments were affected in 46,7% of the injured players. Injury locations were the ankle (34,3%), the knee (13,3%) and

the back (7,6%). The upper limb was affected in 6,7% of the athletes (3,8% shoulder, 1% elbow and 1,9% hand/wrist). Overweight, increased BMI and overtraining may be risk factors for back injuries.

Conclusion: European professional basketball female players have a high incidence of sport related injuries.

Keywords: Basketball; Injuries; Female athletes; Europe; Epidemiology

Introduction

Basketball is a popular sport all around the world in all ages population. Despite the benefits of such a sport for health, it also has its counterparts (6). Among non-contact sports, it is the one that has the highest injury rate, even being superior to some contact sports.[2, 4, 9, 12, 14] Injure mechanisms are player contact first, followed by non-contact, surface contact and overuse.[9, 15]

Taking into account the nature of this sport, it's easy to understand what all studies show: the most commonly injured body region is the lower limb.[1, 2, 3, 5, 12, 15] This is true both in professional[12] and in recreational basketball.[4] Basketball is characterized by high speed, rapid turns, stops and starts, jumps and landings.[5, 9] The knee and back are the main overuse injuries sites and ankle is the main acute injury localization.[2, 5, 9, 14] Overall, the most common basketball injury sites are in first place

the ankle[9], in second the knee, then the head/face/neck, the arm/hand, and the hip/thigh/upper leg.[6, 5, 15] Sprains are the most common injury type.[3, 6] Lateral ankle sprains are, both in men and women, the most common diagnosis and many times athletes report a prior sprain.[3, 7, 9, 15] The majority of ACL ruptures occur between 15 and 25 years of age.[7] Since increased injury occurs concurrently with increasing training load[2], elite teams can provide us more information.

In the various studies already conducted, it was consistent that women have a higher risk of injury than men[1, 2, 3, 5, 7], especially in the knees[3, 6, 7, 12] Anterior cruciate ligament (ACL) rate injuries can be 2 to 8 times higher in women[7, 9, 12, 15] and about 70% of these injuries occur due to landing and side-cut movement of the lower limb.[12] Women also have a higher severe injury rate than men.[15] In terms of lesion distribution, women have more head injuries, such as concussions.[3, 12, 15] Men have more hand and wrist injuries.[3]

Concerns about injuries in basketball players have been focused in the US population, and not enough data is available on European athletes' injuries.[2] These populations are very different, so more studies are needed in Europe.[2]

The aim of this study was to investigate the frequency of overall injuries and associated risk factors among young European female elite basketball players, while characterizing their training habits.

Material and Methods

Study design

A cross-sectional retrospective design was used to analyze several characteristics related to high competition female athletes, from injuries to training habits during their last years of sports practice. This study was approved by FIBA (International Basketball Federation) and was conducted in accordance with the Declaration of Helsinki, approved by our Institution's Ethical Committee.

Participants

The purpose and the procedures of the study were explained to teams' coaches in a brief introduction. The player's participation was voluntary and the athletes who joined the study were elite female basketball players.

Altogether 16 basketball teams participating in the FIBA U20 Women's European Championship from 8 to 16 July 2017, were invited to participate in this study. Of the invited teams, 6 teams declined to participate, so data was collected from 10 teams. Of these, 16 players didn't fill the questionnaire, leading to a total of 105 participating players.

Data collection

All information was collected through a questionnaire. The information collected included personal information such as age, weight, height, age of growth stop, playing experience, menarche, diet and injuries history and training characteristics (annex 1). The questionnaires were delivered to the coaches by the tournament organization before the beginning of the competition and were returned at the end.

Statistical analyses

Statistical analysis was conducted in SPSS Statistics Software (v.24, SPSS, Chicago, Illinois). Means with standard deviations (SD) were calculated to describe continuous data. Frequencies and percentages were used for categorical variables.

The statistical tests used were the one way Anova for comparison of continuous and categorical variables, and the Chi Square test for comparison of categorical variables among each other. Statistical significance was set at α equal to 0,05.

Results

Players' characteristics

Complete data was obtained from 105 female players as described in Table 1.

	Age (Years)	*Weight (kg)*	*Height (cm)*	*Menarche (age)*	*Growth stop (age)*	*Start playing (age)*
Mean ± SD	19,0 ± 1,0	71,2 ± 8,0	179,7 ± 7,3	13,2 ± 1,4	16,5 ± 1,4	9,1 ± 2,4
Range	16,0 – 20,0	56,0 – 98,0	165,0 – 197,0	10,0 – 16,0	14,0 – 20,0	4,0 – 14,0

Table 1. Players´ characteristics. Legend: SD – Standard deviation.

Regarding diet care, 33,3% never beware about food intake, 32,4% are careful only before the games, 32,4% control their diet every day and 1,9% think about their diet "sometimes". Dietary supplements are used by 23,8% of the athletes: 8,6% take BCAA, 6,7% take vitamins, 4,8% take proteins and 3,8% take a mix of supplements.

Injuries' characteristics

Altogether, 81 players (77,1%) sustained at least one injury during their playing experience and 14 (13,3%) of them had multiple injuries. The most common injury location is the ankle (34,3%), followed by the knee (13,3%), back (7,6%), shoulder (3,8%), hand (1,9%) and finally the elbow (1%). Of the athletes who reported multiple injuries, 2 of them had 2 shoulder injuries, 3 in the knee, 9 in the back and 10 in the ankle.

The ligaments are the most affected structures, accounting for almost half the lesions (46,7%), followed muscles (9,5%), bones (fractures – 2,9%) and meniscus (1,9%). Injury of both ligaments and meniscus occurred in 3,8% of the athletes.

During the previous season, 78,1% of the surveyed athletes went to the physiotherapist - 58,1% occasionally and 20% regularly.

Training characteristics

8,6% of the athletes never stretch before practice/games and 10,5% never stretch after; 59% always stretch after and 64,8% always stretch before; 26,7% sometimes stretch before and 30,5% sometimes stretch after.

The time spent exercising by these elite players was calculated as described on Table 2.

	Mean ± SD	***Range***		***Mean ± SD***	***Range***
Cardio (min/week)	175,4 ± 290,4	0,0 – 1500,0	***Cardio (times/week)***	2,7 ± 2,1	0,0 – 10,0
Strenght (min/week)	97,3 ± 108,7	0,0 – 720,0	***Strenght (times/week)***	2,3 ± 1,7	0,0 – 12,0
Flexibility (min/week)	105,2 ± 459,6	0,0 – 4500,0	***Flexibility (times/week)***	3,0 ± 3,0	0,0 – 12,0

Running (min/week)	73,6 ± 104,2	0,0 – 600,0	***Running (times/week)***	1,6 ± 1,8	0,0 – 7,0
Collective (min/week)	627,4 ± 279,9	20,0 – 1440,0	***Collective (times/week)***	5,5 ± 1,7	1,0 – 12,0
Total exercise (min/week)	932,9 ± 730,7	0,0 – 4760,0			

Table 2. Time of exercise. Legend: SD – standard deviation.

Analysis and correlation of the variables

A significant statistic association was found between the athletes who are careful with diet and their weight (p=0,043), but no association was found with the body mass index (BMI) (Table 3). Players who are careful with their diet every day, are heavier than those who only take care before the games and those who are never careful. In turn, those who are careful just before the games are heavier than those who never are.

Careful With Diet		**Weight (kg)**	**BMI (kg/m^2)**
Before games	Mean ± SD	70,7 ± 8,3	22,1 ± 1,7
Every day	Mean ± SD	73,9 ± 8,1	22,4 ± 1,9
No	Mean ± SD	69,1 ± 7,0	21,6 ± 1,3

Table 3. Correlation between Careful with Diet and Weight and BMI. Legend: SD – standard deviation.

It was found a significant statistic association between the intakes of supplements and the age of the athletes (p=0,047) and also with the age of growth stop (p=0,014) (Table 4). Athletes who take supplements are older and stopped growing later than those who don't.

Supplements		Age (years)	Growth Stop (years)
Yes	Mean ± SD	19,3 ± 0,7	17,1 ± 1,5
No	Mean ± SD	18,9 ± 1,1	16,3 ± 1,4

Table 4. Correlation between Supplements and Age and Growth Stop. Legend: SD – standard deviation.

There was also a statistical association between the type of supplement and the time spent running per week (p=0,03) and with the age of growth stop (p=0,37) (Table 5). Athletes who take a mix of supplements, stopped growing significantly later and run more often than the others. The ones who take proteins are the ones that stopped growing sooner and run less often.

SupplementsType		Growth Stop	Running (Times/Week)
BCAA	Mean ± SD	17,3 ± 1,2	3,5 ± 2,0
Proteins	Mean ± SD	16,0 ± 1,4	0,4 ± 0,5
Vitamins	Mean ± SD	17,3 ± 1,4	1,3 ± 0,8
Mix	Mean ± SD	17,8 ± 2,2	3,7 ± 2,9
No	Mean ± SD	16,3 ± 1,4	1,5 ± 1,7

Table 5. Correlation between Supplements type and Growth Stop and Running (Times/Week).

Legend: SD – standard deviation.

Athletes with back injuries are heavier (p=0,019) and taller (p=0,010), and athletes with hand or leg injuries have generally less weight and less height. However this is not true when compared to BMI. Athletes with knee injuries stopped growing earlier than others, and those with injuries in the hands or elbows stopped growing later (p=0,020). Players with injuries in the leg or elbow usually started playing earlier than the others; and those who manifest multiple injuries began later (p=0,041). Hand and back injuries occur in athletes who, on average, do more minutes of aerobic training per week (p=0,013). Injuries in the leg and shoulder occur more in those with less minutes of aerobic workout per week (p=0,013) (Table 6).

Injuries Local	**Weight (kg)** Mean ± SD	**Height (cm)** Mean ± SD	**Growth Stop (years)** Mean ± SD	**Start Playing (years)** Mean ± SD	**Cardio (min/week)** Mean ± SD
Knee	69,4 ± 7,7	175,6 ± 5,9	15,9 ± 1,4	8,1 ± 2,6	164,6 ± 310,7
Ankle	70,3 ± 6,8	179,3 ± 7,3	16,3 ± 1,6	9,1 ± 2,7	103,1 ± 127,1
Back	80,4 ± 11,0	184,9 ± 7,7	16,3 ± 1,3	8,4 ± 2,0	437,5 ± 528,5
Elbow	69,0 ± 0,0	182,0 ± 0,0	19,0 ± 0,0	6,0 ± 0,0	150,0 ± 0,0
Shoulder	70,3 ± 7,8	177,5 ± 9,5	16,3 ± 1,3	7,0 ± 0,8	100,0 ± 69,3

Hand	63,0 ± 0,0	174,5 ± 2,1	20,0 ± 0,0	9,0 ± 1,4	765,0 ± 997,0
Multiple	70,8 ± 9,4	178,6 ± 7,8	17,4 ± 0,9	10,4 ± 2,9	106,4 ± 112,4
Leg	61,5 ± 3,5	169,5 ± 0,7	17,5 ± 0,7	5,0 ± 0,0	75,0 ± 21,2
No	72,5 ± 6,5	183,0 ± 5,8	16,3 ± 1,2	9,5 ± 2,1	208,9 ± 300,3

Table 6. Correlation between Injuries Local and Weight and Height and Growth Stop and Start Playing and Cardio (min/week). Legend: SD – standard deviation.

There was a statistical association between injuries type and age of growth stop (p=0,031) and with time weekly spend in cardio exercises (p=0,035). Athletes with fractures generally stopped growing later and do more aerobic training time per week. Those with ligament injuries stopped growing later than the others. Athletes with meniscus injuries do less aerobic workout per week (Table 7).

InjuriesTypes		**GrowthStop (years)**	**Cardio (min/week)**
Ligaments	Mean ± SD	16,2 ± 1,5	124,8 ± 195,0
Meniscus	Mean ± SD	17,0 ± 0,0	60,0 ± 0,0
Meniscus and Ligaments	Mean ± SD	17,3 ± 1,0	152,5 ± 146,4
Muscles	Mean ± SD	16,8 ± 1,2	370,0 ± 487,7
Fractures	Mean ± SD	19,5 ± 0,7	560,0 ± 789,4
Multiple	Mean ± SD	16,8 ± 1,6	75,0 ± 89,0
No	Mean ± SD	16,3 ± 1,2	208,9 ± 300,3

Table 7. Correlation between Injuries type and Growth Stop and Cardio (min/week). Legend: SD – standard deviation.

Athletes who go to the physiotherapist usually run more often (p=0,019) and longer than those who do not (p=0,033) (Table 8).

Physiotherapist		Running(Min/Week)	Running(Times/Week)
Yes	Mean ± SD	85,8 ± 113,6	1,9 ± 1,9
No	Mean ± SD	30,0 ± 34,3	0,8 ± 0,8

Table 8. Correlation between Physiotherapist and Running (min/week) and Running (times/week). Legend: SD – standard deviation.

Those who go regularly to physiotherapy do on average less collective training time per week. Those who never go to physiotherapy usually run fewer times a week and have a smaller total exercise load per week than the others. Those who go sometimes, run more often (p=0,024), have more collective training time (p=0,037) and a higher total workload per week (p=0,038) (Table 9).

Physiotherapist Frequency		Collective (min/week)	Running (times/week)	Total Exercise (minutes)
Regular	Mean ± SD	488,8 ± 188,9	1,4 ± 1,4	775,8 ± 648,9
Sometimes	Mean ± SD	683,6 ± 297,1	2,0 ± 2,1	1084,2 ± 813,4
No	Mean ± SD	585,0 ± 255,2	0,8 ± 0,8	675,0 ± 424,8

Table 9. Correlation between Physiotherapist Frequency and Collective (min/week) and Running (min/week) and Total exercise (min). Legend: SD – standard deviation.

Players with back injuries have, on average, more weight (p=0,031), higher BMI (p=0,008) and train collectively more times per week (p=0,038) (Table 10).

Injuries Back		BMI	Weight	Collective (Times/Week)
No	Mean	21,8 ± 1,5	70,4 ± 7,0	5,3 ± 1,7
Yes	Mean	23,0 ± 2,4	74,9 ± 11,3	6,3 ± 1,8

Table 10. Correlation between Injuries Back and BMI and Weight and Collective (times/week). Legend: SD – standard deviation.

Athletes without history of knee lesion, usually go more regularly to the physiotherapist than those who have had injuries (p=0,026) (Table 11).

		Physiotherapist Frequency		
		Regular	No	Sometimes
InjuriesKnee	No	13	18	54
	Yes	8	5	7

Table 11. Correlation between Injuries Knee and Physiotherapist. Legend: SD – standard deviation.

No statistically significant association was found between stretching and injuries.

Discussion

This study reveals that the overall distribution of injuries was consistent with the literature. 77,1% sustained at least one injury during their playing experience and they are mainly in the lower limb (49,5%). Cumps *et al.*[2] found a prevalence rate of lesions lower than ours (67,7%) and Deitch *et al.*[3] found 65,7% of lower limb injuries, higher than in our study. Previous injury is the main risk factor for injury[10], so it is natural that 13,3% of athletes reported multiple injuries.

The most common injury locations in our population were the ankle (34,3%), the knee (13,3%) and the back (7,6%). The upper limb was affected in 6,7% of the athletes (3,8% shoulder, 1% elbow and 1,9% hand/wrist). More than half of these lesions are ligamentous (60,4%) and a large part are muscular (12,3%). 3.7% are fractures and 2,4% meniscus tears. Lateral ankle sprains are mainly result from an inversion injury with the foot in slight plantar flexion, when a player lands badly, rolling the ankle inward.[9] In the lower leg, several soft tissue conditions may result from overuse, such as musculotendinous strain and contusion, muscle herniation, and tendinosis.[9] The high prevalence of knee injuries is easily explained by the type of sport practiced, with a high frequency of jumping, intermittent sprints, frequent stops and starts and by the diversity of injuries.[9] About 70% of all ACL injuries are noncontact injuries that occur secondary to a landing or side-cut motion of the lower extremity[12], deceleration and/or sudden change in direction that cause abnormal rotation of the

tibia.[9] Overuse injuries at the knee predominate at the extensor apparatus and specially the patellofemoral joint, resulting from the decelerations and jumping who lead to microscopic tendon tear.[9] ACL reconstruction is the most common surgical procedure performed in female athletes[7, 12] and meniscus surgery is the second.[12] The low back is especially affected in young athletes due to the immature skeleton that is vulnerable to excessive loading during growing peak.[5] Furthermore, history of low back disorder increases three to six times the risk of new low back pain.[5]

The literature is sparse, with variable results. Cumps *et al.*[2] had an older sample than ours and included men, but they also found that the lower limb is the site of more injuries and that ankle sprains and knee overuse injuries are the most common. Leppänen *et al.*[5] reinforce our findings, although they had a younger sample than ours and only evaluated overuse lesions. But within these, they found that those in the knee and the lower back are the most prevalent. The most frequent types are muscular and tendinous. Zuckerman *et al.*[15] found that the knee was the target site of the largest proportion of severe injuries. As it is also more common in women, it can explain the fact that we did not find such a high prevalence as expected: the athletes either quit the sport or did not participate in the competition.[9, 15] An ankle sprain was also the most diagnosed lesion.[15] McCarthy *et al.*[7] did a study with WNBA athletes that are slightly older than ours (means: 19y vs 22,2y). They reported 47,8% of ankle sprains, 17% injuries in the knee, 20,8% in the hand/wrist and 4,8% in the shoulder. These frequencies are higher than the ones we found. The fact that they had a

significantly larger sample, allowed them to register more lesions, which may explain this difference. Deitch *et al.*[3] found a different distribution than ours but a similar nature of lesions, despite being WBNA athletes and older than ours (19y vs 24.3y).

We found that athletes with back injuries have, on average, more weight, higher BMI and train collectively more times per week than those who don't. As so, overweight, increased BMI and overtraining may be risk factors for back injuries.

We also verified that athletes with knee injuries stopped growing earlier than others, and those with injuries in the hands or elbow stopped growing later. One can assume that lesions that affect the knee, where the main growth cartilages in the lower limb are found, can have a repercussion on the growth of these young women. Further studies in this area are needed to confirm and explain this data.

During the previous season, 78,1% of the surveyed athletes went to the physiotherapist - 58,1% occasionally and 20% regularly. We can deduct that those who went sometimes only did so for the treatment of acute injuries. This percentage is in line with the findings of McKay *et al*[8] who observed that 56,3% of the population used the physical therapy to treat injuries. However, it differs a great deal from our data in that only 38,3% of all its athletes resorted to the physiotherapist. Athletes who attend the physiotherapist regularly usually run more often and more time than those who don't, which in turn have a smaller total exercise load per week. The regulars do on average less collective training time per week. Those who go sometimes run more

often, have more collective training time and a higher total workload per week. This set of observations allows us to presume that the more physical load there is, the more athletes attend to physiotherapy which is an indirect sign of injuries. This is in favor of the findings of Weiss *et al.*[13], who described an intermediate loading point where the athletes have fewer injuries, if they practice the right amount of time; although it can not be generalized to all athletes. Also, abrupt changes in the acute workload can increase the risk of injuries, especially if the usual training load is low.[5] The ones who train less go fewer times to the physiotherapist. We can question if less training is a protective factor on injuries; however, there was no statistically significant association between "less training" and "fewer injuries".

Although we have not found that stretching has an impact on the prevalence of lesions, reducing the risk of acute non-contact injuries of the lower limbs is possible with specific warm-up programs like FIFA 11+ or neuromuscular training.[1, 6]

Regarding nutrition, 76,7% of athletes are careful with their diet, even if it is only sometimes or before the games, and 23,8% claim to ingest supplements. According to the literature, when it comes to maximizing training, especially for carbohydrate intake, most of the work focuses on endurance modalities. The availability of carbohydrates becomes a limiting factor in the performance of prolonged (> 90 minutes) sessions.[11] In what concerns the stimulation of muscle protein, the protein plays a fundamental role since after strength exercises, the

protein balance continues negative until there is protein intake.[11] This may explain why 13,4% take protein-related supplements.

The major strength of this study is its sample. The studied population consists of high competition female elite athletes, from several European countries. We are not aware of any studies that have characterized this type of population.

However, it also has several limitations. The first one is the fact that 6 of the 16 teams participating in the European championship did not participate in the study, given its voluntary nature. Also, not all athletes responded to the full survey. Another limitation is common to all retrospective studies: recall bias. All injuries were classified using a self-reported injury questionnaire. As so, the athlete's may not remember all injuries and the study is dependent on the accuracy of the data. It's common for athletes with overuse injuries, or even acute injuries, to continue training and competing, despite decreased functional performance, pain, and other injury related symptoms.[13, 14] Non-time-loss injuries represent more than 50% of total injuries[15] and players are used to certain levels of pain and therefore didn't identify themselves as injured.[14] On the other hand, we are also assuming that the reported lesions are medically valid. So, the numbers of actual injuries documented may not truly reflect the reality. We may also take into account that younger players who were injured more severely did not continue to play (survival effect).

Acknowledgment

To Dr. Márcia Sá, for the valuable help with the statistical analysis, without which this work would not be possible.

To Dr. João Torres, for his constant patience and sympathy.

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Annex 1

Survey delivered to the athletes.

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FMUP FACULDADE DE MEDICINA
UNIVERSIDADE DO PORTO

Basketball training habits and injuries

This questionnaire aims to collect information about your physical practice, basketball training and injuries. This methodological instrument is part of an investigation in the scope of a Master degree in Medicine, University of Porto.

All information collected is strictly confidential.

Please answer honestly, there are no right or wrong answers. Your opinion is very important. Your participation is voluntary.

1. Nationality: _____
2. Age: ____
3. Weight: _____ kg
4. Height: _____ cm
5. Menarche (age of first menstrual bleeding): _____
6. Age of growth stop: _____
7. Are you careful with your diet? (Increased intake of proteins, carbohydrates, fluids, etc.)

   ☐ No

   ☐ Only before games

   ☐ Every day

   Other: _____

8. Do you take supplements?

   ☐ No

   ☐ Yes. Which? _____

9. Since when do you play basketball? (age) _____

10. Training

Type of training	Duration	Frequency (per week)
Gym – cardio		

Gym – strength		
Gym – flexibility		
Collective training		
Running		
Other _____		

11. Do you stretch?

☐Only before training ___ Always ___ Sometimes ___ Occasionally

☐Only after training ___ Always ___ Sometimes ___ Occasionally

☐Before and after training ___ Always ___ Sometimes ___ Occasionally

☐Never

12. Injuries

Location	**Injury**	**Age**	**Treatment**	**Comments**
Knees				
Shoulders				
Ankles				
Hands/Wrists				
Lower back				
Other _____				

13. How many times did you go to the physiotherapist last season? _____

Thank you very much!

Matilde Oliveira Pinto

Annex 2

American Journal Of Sports Medicine Manuscript Guidelines.

AJSM Manuscript Submission Guidelines

The *American Journal of Sports Medicine* (AJSM) is the official publication of the American Orthopaedic Society for Sports Medicine.

The editor of AJSM, Bruce Reider, can be contacted via email at breider@ajsm.org.

Manuscripts must not be under simultaneous consideration by any other publication, before or during the peer-review process. Papers presented at AOSSM meetings must be submitted to the Journal for first rights of refusal. Authors are responsible for submitting papers of presentations directly to the Journal. Articles published in AJSM may not be published elsewhere without written permission from the publisher.

Manuscripts should cite any other work by one or more of the co-authors that is relevant to the subject matter of the current submission or that used any of the same subjects, animals, or specimens being reported in the current submission. This includes manuscripts that are currently under preparation, are being considered by journals, are accepted for publication, or already published. In any of these cases, the relationship to the current submission should be made clear.

All review articles (such as systematic review, meta-analysis) submitted will be considered for the Current Concepts section. Authors with ideas for current concepts should contact the associate editor, Timothy Foster, MD, to find out if AJSM has recently published a review article on that topic of if there is a similar submission in progress. Contact Dr Foster at info@ajsm.org to inquire about your idea or submit already completed papers directly to the journal at http://ajsm-submit.highwire.org.

SUBMISSIONS

Authors should register on our online submission site at http://ajsm-submit.highwire.org/ to submit manuscripts.

When manuscripts have been received by the editorial office, the corresponding author will be sent an acknowledgment giving an assigned manuscript number, which should be used with all subsequent correspondence for anything related to that particular manuscript.

The following items are required on submission:

1. The blinded manuscript including the abstract and any tables and figures where they occur in the text. No identifying information should appear in the uploaded manuscript. Please remove author names, initials, and institutions. State or country names may be used, but do not include specific locations such as cities or regions.
2. The Journal Contributor Publishing Agreement and AJSM Author Disclosure Statement. These forms are available for download from the author area of the submission site. The corresponding author must complete the forms and return them to AJSM by email or upload them online as a PDF or Word file using the "upload legal documents" option. As an alternative to the AJSM disclosure form, authors may submit the ICMJE disclosure form *along with* the AJSM supplemental form available on our website.
3. A copy of the IRB or other agency approval (or waiver) if animal subjects or human subjects or tissues or health information were used. Please see further instructions on page 2 under "Text." This information should be uploaded with the disclosure and publishing forms and not as a supplemental file.
4. The original study protocol for all registered clinical trials must be included and can be uploaded as a supplemental file. This information should be blinded for peer review (remove author name and location as well as trial registration number). Use of a CONSORT flow diagram is required to illustrate the grouping and flow of patients for all randomized clinical trials. The CONSORT checklist must also be completed and uploaded as a supplemental file.

Cover letter, acknowledgments, and suggested reviewers are optional. If a paper has more than 5 authors, a cover letter detailing the contributions of all authors should be included in the appropriate box on the submission page. Only those involved in writing the paper should be included in the author line. Others should be listed as a footnote or acknowledgment. While there is no limit on the number of authors, no more than 12 will be listed on the masthead of the published article; additional authors will be listed at the end of the article.

MANUSCRIPT FORMATS

Manuscript pages should be double-spaced with consecutive page numbers and continuous line numbers. The abstract should be included with the manuscript as well as being entered in the Metadata section (except for case reports, which do not require abstracts). Manuscripts should be 6000 words or fewer (including abstract and references). There are also limitations on figures, tables, and references; see guidelines below. The system handles most common word processing formats; however, Word and PDF are preferred.

MANUSCRIPT PREPARATION

Abstract

Abstracts should summarize the contents of the article in 350 words or less. The abstract should be structured in the following format:

Background: In one or two sentences, summarize the scientific body of knowledge surrounding your study and how this led to your investigation.
Hypothesis/Purpose: State the theory(ies) that you are attempting to prove or disprove by your study or the purpose if no hypothesis exists.
Study Design: Identify the overall design of your study. See list below.
Methods: Succinctly summarize the overall methods you used in your investigation. Include the study population, type of intervention, method of data collection, and length of the study.
Results: Report the most important results of your study. Only include positive results that are statistically significant, or important negative results that are supported by adequate power. Report actual data, not just *P* values.
Conclusion: State the answer to your original question or hypothesis. Summarize the most important conclusions that can be directly drawn from your study.

Clinical Relevance: If yours was a laboratory study, describe its relevance to clinical sports medicine.
Key Terms: Include at least 4 key terms for indexing. When submitting an article, you will be asked to choose from a list of terms that are used for assigning reviewers. These terms can be used in the manuscript as well. The list can be found at http://ajsm-submit.highwire.org/submission/editexpertise
What is known about the subject: Please state what is currently known about this subject to place your study in perspective for the reviewers.
What this study adds to existing knowledge: Please state what this study adds to the existing knowledge.

The last two items are for reviewers only and are not included in the word count, but should appear at the end of the abstract in the uploaded text.

Study Designs

Meta-analysis: A systematic overview of studies that pools results of two or more studies to obtain an overall answer to a question or interest. Summarizes quantitatively the evidence regarding a treatment, procedure, or association.
Systematic Review: An article that examines published material on a clearly described subject in a systematic way. There must be a description of how the evidence on this topic was tracked down, from what sources and with what inclusion and exclusion criteria.
Randomized Controlled Clinical Trial: A group of patients is randomized into an experimental group and a control group. These groups are followed up for the variables / outcomes of interest. **NOTE: All clinical trials started after January 1, 2016 must be registered at ClinicalTrials.gov or a similar database to be considered for publication.**
Crossover Study Design: The administration of two or more experimental therapies one after the other in a specified or random order to the same group of patients.
Cohort Study: Involves identification of two groups (cohorts) of patients, one which did receive the exposure of interest, and one which did not, and following these cohorts forward for the outcome of interest.
Case-Control Study: A study that involves identifying patients who have the outcome of interest (cases) and patients without the same outcome (controls), and looking back to see if they had the exposure of interest.
Cross-Sectional Study: The observation of a defined population at a single point in time or time interval. Exposure and outcome are determined simultaneously.
Case Series: Describes characteristics of a group of patients with a particular disease or who have undergone a particular procedure. Design may be prospective or retrospective. No control group is used in the study, although the discussion may compare the results to other published outcomes.
Case Report: Similar to the case series, except that only one or a small group of cases is reported.
Descriptive Epidemiology Study: Observational study describing the injuries occurring in a particular sport.
Controlled Laboratory Study: An in vitro or in vivo investigation in which 1 group receiving an experimental treatment is compared to 1 or more groups receiving no treatment or an alternate treatment.
Descriptive Laboratory Study: An in vivo or in vitro study that describes characteristics such as anatomy, physiology, or kinesiology of a broad range of subjects or a specific group of interest. Authors should choose the design that best fits the study.

The Editor will make the final determination of the study design and level of evidence based on the Center for Evidence Based Medicine guidelines.

Text

In general, follow the standard IMRAD (Introduction, Materials and Methods, Results, Discussion) format for writing scientific articles. The author is responsible for all statements made in the work, including copyeditor changes, which the author will have an opportunity to verify. Authors with limited fluency in English should have the paper reviewed or edited by a native English speaker to ensure clear presentation of the work.

Papers including human or animal subjects must include a statement of approval by appropriate agencies in the text, and a copy of the approval letter must be uploaded with the submission. If approval was not required, authors must upload a waiver statement from the appropriate agency. For human cadaveric specimens, please provide source (eg, donation to university anatomy program) and state if permission was obtained for use. Additionally, all studies involving animals must conform to ARRIVE guidelines. If available, please include the source of animal joint or tissue specimens. For case reports, include a letter from the patient granting permission for his/her information to be included in the publication.

Reports on surgery, except in rare instances, require a minimum follow-up of 2 years.

Use generic names of drugs or devices. If a particular brand was used in a study, insert the brand name along with the name and location of the manufacturer in parentheses after the generic name when the drug or device is first mentioned in the text.

Use metric units in measurements (centimeter vs inch, kilogram vs pound).

Abbreviations should be used sparingly. When abbreviations are used, give the full term followed by the abbreviation in parentheses the first time it is mentioned in the text, such as femur-ACL-tibia complex (FATC).

Use of a CONSORT flow diagram is required to illustrate the grouping and flow of patients in all randomized controlled trials and is recommended for all other types of clinical studies.

Statistical methods should be described in detail. Actual *P* values should be used unless less than .001. Reporting of 95% confidence intervals is encouraged.

Acknowledgment

Type the acknowledgments in the box provided on the submission page; do not include it in the manuscript. This information will be added to the accepted manuscript at the time of publication. Give credit to technical assistants and professional colleagues who contributed to the quality of the paper but are not listed as authors. Please briefly describe the contributions made by persons being acknowledged. **Note: anyone who has contributed to the preparation of the submitted text must be included on the author disclosure form, under Statement of Authorship, and his or her disclosures included there.**

References

References should be double-spaced in alphabetical order and numbered according to alphabetical listing. Except for review

articles, references should be limited to 60. If references are not in alphabetical order the uploaded file will be REJECTED and will have to be resubmitted with the references in the correct form. When author entries are the same, alphabetize by the first word of the title. In general, use the Index Medicus form for abbreviating journal titles and the *AMA Manual of Style* (10th ed) for format. *Note:* References must be retrievable. Do not include in the reference list meeting presentations that have not been published. Data such as presentations and articles that have been submitted for publication but have not been accepted must be put in the text as unpublished data immediately after mention of the information (for example, "Smith and Jones (unpublished data, 2000) noted ..."). Personal communications and other references to unpublished data are discouraged. For review purposes, unpublished references that are closely related to the submitted paper or are important for understanding it should be uploaded as supplemental files.

References will be linked to Medline citations for the reviewers. Authors can include articles that are in Epublish mode. To ensure that these Epub references are linked correctly, please provide the PMID number from Medline at the end of the reference. For example: Emery CA, Meeuwisse WH. Injury rates, risk factors, and mechanisms of injury in minor hockey. *Am J Sports Med*. 2006 Jul 21; [Epub ahead of print] PMID: 16861577

Figures and Tables

Figures and tables should appear in the body of the paper near the place where they are mentioned. High-resolution images should also be uploaded separately as Figure files. The figures and tables should be cited in numeric order in the text and should not exceed 3 journal pages. One journal page equals 1 large table or figure, 2 medium-sized tables or figures, or 4 small tables or figures. Medium-sized tables and figures will be a page width and half the length of the page; small tables and figures are 1-column width and take up half the length of the page or less.

Any material that is submitted with an article that has been reproduced from another source (that is, has been copyrighted previously) must conform to the current copyright regulations. It is the author's responsibility to obtain written permission for reproduction of copyrighted material and provide the editorial office with that documentation before the material will be reproduced in the Journal.

All image files for figures should be labeled with the Figure number (label each part if figures include multiple parts, eg, 2A, 2B). The figure legend should be placed below each figure and should include descriptions of each figure part and identify the meaning of any symbols or arrows. Terms used for labels and in the legend must be consistent with those in the text. A CONSORT flow diagram should be included for all randomized clinical trials to illustrate the grouping and flow of patients.

Color will be used in the Journal where needed (eg, histology slides or surgical photographs). All other figures, such as bar graphs and charts, should be submitted in black and white.

Figures for papers accepted for publication must meet the image resolution requirements of the publisher, Sage Publications. Files for line-based drawings (no grayscale) should ideally be submitted in the format they were originally created; if submitting scanned versions, files should be 1200 dots per inch (dpi). Color photos should be submitted at 600 dpi and black-and-white photos at 300 dpi.

Charts and graphs can be submitted in the original form created (eg, Word, Excel, or PowerPoint). Photographs or scanned drawings embedded in Word or PowerPoint are not acceptable for publication.

All photographs of patients that disclose their identity must be accompanied by a signed photographic release granting permission for their likeness to be reproduced in the article. If this is not provided, the patient's eyes must be occluded to prevent recognition.

For tables, the system accepts most common word processing formats. Tables should have a title that describes the content and purpose of the table. Tables should enhance, not duplicate, information in the text.

Videos

Use of supplementary video is encouraged. Videos may be submitted with a manuscript and, if approved by the editor, will be posted online with the article when published. Video submission is strongly encouraged for manuscripts reporting surgical, examination, or exercise techniques or injury mechanisms. For more information about the format requirements for videos, please review the Video Format Guide. For detailed information pertaining to copyright and permissions requirements, view the Video Permission and Fair Use Quick Guide. For videos with identifiable subjects, subjects will need to sign the Audio-Visual Likeness Release form. It is the author's responsibility to submit signed release forms, if necessary, for each video.

ACCEPTED MANUSCRIPTS

Once an article is accepted and typeset, authors will be required to carefully read and correct their manuscript proofs that have been copyedited by the publisher. Any extensive changes made by authors on the proofs will be charged to authors at the rate of $2 a line. Authors are responsible for ordering reprints of their articles. Completed articles will be published on our website before print publication.

NIH-Supported Studies

Authors of studies funded by grants from the National Institutes of Health can deposit a copy of their accepted final peer-reviewed manuscript and associated figure/table files (pre-typeset versions) to the NIH database after a 12-month embargo period from the time their article is published in AJSM.

Annex 3

Authorization of the Ethics Committee for Health of the Hospital of São João.

Parecer da Comissão de Ética para a Saúde do

Centro Hospitalar de São João / Faculdade de Medicina da Universidade do Porto

Título do Projecto: European elite female basketball players' injuries and training characterization

Nome da Investigadora Principal: Matilde Martins Cardoso de Oliveira Pinto, aluna do Mestrado Integrado em Medicina da FMUP

Onde decorre o Estudo: Estudo a ser desenvolvido junto de participantes em competição internacional da FIBA (campeonato europeu de sub-20, em 2017)

Objectivos do Estudo:

Caracterização da população de atletas de competição de basquetebol.

Estudo realizado no âmbito do Mestrado Integrado em Medicina da FMUP, sob orientação do Prof. Doutor João Manuel Costa Ferreira Torres.

Concepção e Pertinência do estudo:

Estudo transversal retrospectivo para analisar várias características relacionadas com atletas de alta competição. Todas as informações serão recolhidas através de um questionário a ser enviado à atletas que participaram no campeonato europeu de sub-20, em 2017, e que inclui questões sobre idade, peso, altura, idade de paragem de crescimento, experiência de jogo, menarca, dieta, lesões ocorridas e características do treino.

Benefício/risco: O incómodo do preenchimento de um questionário.

Confidencialidade dos dados:

Não é recolhida informação relativa à identidade.

Respeito pela liberdade e autonomia do sujeito de ensaio:

Tidas em consideração no cabeçalho do questionário.

***Curriculum* da investigadora**: Adequado à investigação.

Data previsível da conclusão do estudo: Dezembro de 2018

Conclusão: Proponho um parecer favorável à realização deste projecto de investigação.

Porto, 16 de Fevereiro de 2018

O Relator da CES, Doutor Pedro Brito

LISTA DE DOCUMENTOS ANEXOS

- [ ] Pedido de autorização ao Presidente do Conselho de Administração do Centro Hospitalar de São João *(se aplicável)*
- [x] Pedido de autorização à Diretora da Faculdade de Medicina da Universidade do Porto *(se aplicável)*
- [x] Protocolo do estudo
- [ ] Declaração do Diretor de Serviço onde decorre o estudo
  (sendo um estudo na área de enfermagem deve anexar também a concordância da chefia de enfermagem)
- [ ] Profissional de ligação
- [x] Informação dos orientadores
- [ ] Informação ao participante
- [ ] Modelo de consentimento
- [x] Instrumentos a utilizar *(inquéritos, questionários, escalas, p.ex.)*: inquérito
- [x] Curriculum Vitae abreviado *(máx. 3 páginas)*
- [ ] Protocolo financeiro
- [ ] Outros:

COMPROMISSO DE HONRA E DECLARAÇÃO DE INTERESSES

Declaro por minha honra que as informações prestadas neste questionário são verdadeiras. Mais declaro que, durante o estudo, serão respeitadas as recomendações constantes da Declaração de Helsínquia (1960 e respetivas emendas), e da Organização Mundial da Saúde, Convenção de Oviedo e das "Boas Práticas Clínicas" (GCP/ICH) no que se refere à experimentação que envolve seres humanos. Aceito, também, a recomendação da CES de que o recrutamento para este estudo se fará junto de doentes que não tenham participado em outro estudo, nos últimos três meses. Comprometo-me a entregar à CES o relatório final da investigação, assim que concluído.

Porto, 2 *de* Fevereiro *de* 2018

Nome legível: Matilde Oliveira Pinto

Matilde Oliveira Pinto
assinatura

Parecer da Comissão de Ética do Centro Hospitalar de São João/ FMUP Emitido na reunião plenária da CE de 16 / 02 / 18

A Comissão de Ética para a Saúde APROVA por unanimidade o parecer do Relator, pelo que nada tem a opor à realização deste projecto de investigação.

Prof. Doutor Filipe A...
Presidente da Comissão de Ética