Blanquerna
UNIVERSITAT RAMON LLULL
Facultat de Ciències de la Salut
BARÇA INNOVATION HUB
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# Injury incidence and relationship between screening tools and performance tests in high level youth female volleyball players: An observational study

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2019/2020 - 2ª convocatoria

## INDEX

## ABSTRACT

**Introduction:** Volleyball is one of the most popular sports in the world yet there is limited knowledge about the risk factors for injury, especially for high level female youth volleyball. The purpose of this study is to investigate the injury incidence and the correlation between demography, screening tools and risk of injury. **Methods:** An observational study with high level female youth volleyball players aged 16-19 and uninjured at the time of participation from one club Barça Femení CVB Júvenil A with the main variable being if the players were injured in the 2019/20 season. Injury data were collected retrospectively through a questionnaire, whereas demography and test scores were collected prospectively with guidance of a written explanation and graphic illustration of the correct procedure to each participant to be performed from home during COVID-19 isolation. The tests include: Weight-Bearing Lunge Test, Single Leg Hop for Distance, Counter Movement Jump with and without arm swing, Apley Scratch Test. **Results:** Two injuries occurred in the 2019/20 season and were found to be significantly correlated with age and Single Leg Hop Test for Distance, whereas previous injuries were found to be significantly correlated with Counter Movement Jumps with and without arm swing. **Conclusion:** A larger sample size over a prospective period is needed to validate the findings in this study. However, the descriptive data as well as the methodology in this study may be valuable to future studies for comparison and incentive to initiate further research on the topic.

**Keywords:** volleyball, female, youth, injury incidence, screening tools

## INTRODUCTION

Volleyball has within the last decades grown to be one of the most popular sports in the world amongst men and women (1,2). Volleyball is assumed to be a relatively safe sport compared to other popular team sports, however, as with any competitive sport there is a definite risk of injury that must be discovered, recognized, and managed (2). The risk factors, injury incidence and injury

epidemiology all vary from sport to sport, where in volleyball most injuries occur as a result of jumping, landing, spiking and blocking being major parts of the sport-specific tasks (3,4).

Although volleyball separates itself from other popular team sports by being a non-contact sport, the movement patterns involved in the sport makes it comparable to beach volleyball, basketball and handball (2). As there is limited research in volleyball, and more specifically female youth volleyball, it is most relevant to draw parallels to similar team sports. Like volleyball, the physical demands of basketball include frequent jump landings and change of direction, with 31% and 10% of movements consisting of lateral shuffling and sprints, respectively (5,6). In volleyball, basketball and handball, the lower extremity is the most injured region, with the most common injured body parts being the ankle and the knee in all three sports (3,5,7-9). Sprains (25-52%), muscle strains (14-27%) and contusions (12-25%) are similarly the most common injury types with a comparable distribution among all three sports (5,8). The injury incidence for volleyball players is 10.3/1000 player hours with a 3–5 times higher incidence in female than male athletes, which increases the interest to focus more on injury prevention in female athletes (3,6). Furthermore, female collegiate players demonstrated a threefold increase in time-loss injuries than that of high-school players (10,11). With the growing youth participation rate, it is important to analyze the epidemiology and prevention of volleyball injuries as they move into the higher risk of injury in collegiate and adult participation (11).

In order to manage this risk, development of screening tools, especially for the ankle and knee joints are needed and should serve as an essential component to a specific injury prevention training program for volleyball players (2,7,12). A variety of intrinsic factors predisposing athletes to injury have been documented in the literature, including female gender and history of prior musculoskeletal injury (13). However, in order for these prevention programs to be effective, they must be designed to target potential, modifiable risk factors (2,14). Functional or physical performance tests (PPTs) were developed as measures of function and, amongst other purposes, used as preseason screening examinations to highlight which athletes might be in higher risk of injury

using objective and validated tests. PPTs were defined as single, low technology tests that require minimal personnel, are quick to administer and attempts to measure constructs related to sport strength, power and agility, which is exactly what the literature had been asking for (7,12,15).

Previous studies have commented on the importance of observational research when evaluating injury risk factors such as demographics, biomechanics and fitness level (12). For this reason, the general objective of this observational study is to observe, analyze and describe which screening tools, performance tests and demographics that are associated with a higher injury incidence in high level female youth volleyball players. Specific objectives include investigating if there is a correlation between tests or demographics. The hypothesis of this study is that injury incidence in high level female youth volleyball players correlates to screening tools, performance tests and demographics.

## METHODOLOGY

### DESIGN

An observational study

### PARTICIPANTS

High-level female youth volleyball players from *Barça Femení CVB Júvenil A*. Inclusion criteria: female, 16-19 years old, high level volleyball player, actively participating in team practices and/or matches. Exclusion criteria: currently injured. All players from the team were invited to join the study verbally through online team chats during COVID-19 isolation and non-verbally with the information document for them and their parents to read (Annex 1). Consent was given by the head coach of the team before commencing the recruitment of players to this study (Annex 2). The study was approved by the research ethics committee of *Facultad de Ciencias y de la Salud Blanquerna* (CER-FCSB) the 20$^{th}$ of April 2020 (Annex 3). Following the Helsinki Declaration of ethical principles for medical research involving human subjects every precaution was taken to protect the privacy of research subjects and the confidentiality of their personal information (16). This was ensured by making all stored data only

identifiable to each participant by the author of the study by allocating a random number to represent each participant, following the General Data Protection Regulation (GDPR) (17).

Recognizing that more data are being stored digitally in the modern society, a guarantee of digital rights and data protection was ensured following the new Spanish Organic Law 3/2018 of December 5 on Data Protection and Guarantee of Digital Rights (LOPDGDD) (18). The recruitment of participants was done by the author of the study, by explaining in understandable language, the nature of the study including the objectives and any possible inconvenience this may cause. Of the 20 eligible subjects six subjects accepted to enter the study and only four subjects contributed data to the study as two subjects failed to complete study requirements including signing the informed consent thus excluding any of their data from being used in this study. 14 subjects did not respond to the invitation of the study despite several invitations being made by the head coach of the team and the author of the study at multiple occasions. Before participating in the study informed written consent was collected by the author of the study from all participants and their parents or legal guardian if under 18 years old (Annex 4 and 5). Participation must be voluntary, and each participant had the right to self-determination at any time by signing the revocation document (Annex 6).

## SAMPLE SIZE

Convenience sampling was used in this study as all the participants were selected from the same team, all female, all 16-19 years old and all playing high-level volleyball. As this is a type of non-probability sampling and no sample size calculation was made the results cannot be generalised (19).

## TESTS

The applied tests were performed once and required the following material: tape, tape measure, marker and smartphone. The tests used in this study include: Weight-Bearing Lunge Test, Single Leg Hop for Distance, Counter Movement Jump with and without arm swing using the app MyJump2, Apley Scratch Test (5,20-22). Each participant performed the tests and measured the

results from home during COVID-19 isolation through a guided step-by-step written explanation by the author of the study to ensure the quality of the tests and minimise the risk of wrongful execution and measurement (Annex 7). The participants must first have read and understood each description explaining in detail how to perform the tests and how to measure their score which was done immediately after performing them to ensure the data validity and accuracy. To avoid misunderstandings due to language, a Spanish translation was made available to the participants as well. Before performing any of the tests, each participant must have performed a short 5-10-minute warm-up program consisting of jogging in place or jumping rope, jumping jacks, burpees, squats and lunges. Three practice attempts were needed for each jumping test before performing three jumps of maximal effort to increase familiarization of each test. A coin flip determined a right or left extremity start in all unilateral tests to ensure true randomization of test scores, eliminating the free choice of starting with a preferred side. The tests adopted an easy-to-implement method with little to no material required (2,3,7,12,15).

## DATA COLLECTION

### INDEPENDENT VARIABLES

Demography data were collected online through a questionnaire (Annex 8). Independent variables: age, weight, height, and previous injuries. Test data were collected online by having the participants fill out the performance & measurement test document (Annex 7). For the Counter Movement Jump tests with and without arm swing each participant had recorded their jumps excluding their face and sent the video to the author of the study via the official Blanquerna – Ramon Llull University email. Independent variables: test scores; reach, distance, and height.

### DEPENDENT VARIABLES

Injury data were collected online through a questionnaire (Annex 8). The data were collected retrospectively from the 2019/20 season up until time of cancellation of all play due to COVID-19. Dependent variables: injury location, injury mechanism, injury severity, contact or non-contact, if the injury happened during training or match and if the injury happened during time of menstruation.

STATISTICAL ANALYSIS

Univariate and bivariate analysis were conducted in the IBM SPSS statistics version 26. Descriptive data (mean±SD) were obtained for all quantitative variables. Pearson´s correlation coefficient (Pearson´s r) was used to analyse the correlation between variables, where $p < 0.05$ was regarded as significant. Univariate analysis has a significant role in statistical analysis as it is useful to find errors inside datasets, to describe and gather basic information and to aggregate data. Bivariate statistics is used in research to analyze two variables simultaneously and is a mandatory step to describe the relationships between the observed variables. There are two types of variables in bivariate analysis. One variable is defined as the outcome or dependent variable and the other as the explanatory or independent variable.

Bivariate analysis assesses how the value of the dependent variable can be explained or depends on the value of the independent variable. In this study, the dependent variable is the data retrospectively collected for injuries during the 2019/20 season, and the independent variables are the data collected for the demography, screenings and tests. Pearson´s r used in this study is used to determine any relationship, link or correspondence between two variables. The statistic representing how closely two variables co-vary takes a value from -1 (perfect negative correlation) through 0 (no correlation) to +1 (perfect positive correlation). The stronger the correlation the closer to ±1 the correlation coefficient comes (23). Both bivariate- and univariate analysis are basic and necessary steps before proceeding to more complex multivariate analysis (24).

## RESULTS

A total of two injuries were documented during the 2019/20 season. Both injury locations were in the lower extremity. One participant suffered a severe foot injury in the right side, >28 days time-loss, with unknown injury mechanism and was able to continue practice on the day of injury. And one participant suffered a moderate lower leg injury in the left side, 8-28 days time-loss, where the injury mechanism was blocking, spiking and serving and was unable to continue practice on the day of injury. Both injuries occurred gradually, both

were non-contact and neither injury happened during time of menstruation. Two participants presented with previous injuries. One had previously suffered an ankle sprain but was not injured in the 2019/20 season. And one had previously suffered an ankle sprain, lumbar scoliosis and periostitis and was injured in the lower leg in the 2019/20 season. Means and standard deviations for demography and test scores are presented in Table 1.

Table 1
Descriptive statistics (Mean ± SD)

| *Demography* | |
|---|---|
| | Total (N = 4) |
| Age | 18.50 ± .57 |
| Height (m) | 172 ± 12.27 |
| Weight (kg) | 67.25 ± 10.81 |
| Previous injuries | .50 ± .57 |
| Injury in 2019/20 season | .50 ± .57 |

| *Tests* | (cm) |
|---|---|
| Apley Scratch Test - Left | .00 ± .00 |
| Apley Scratch Test - Right | 2.50 ± 5.00 |
| Weight-Bearing Lunge Test - Left | 9.95 ± 3.38 |
| Weight-Bearing Lunge Test - Right | 9.80 ± 3.99 |
| Single Leg Hop Test - Left | 149.50 ± 12.55 |
| Single Leg Hop Test - Right | 154.50 ± 12.23 |
| Counter Movement Jump - With arm swing | 28.17 ± 5.54 |
| Counter Movement Jump - Without arm swing | 23.27 ± 7.91 |

Both age and Single Leg Hop Test for Distance had a significant correlation to injury incidence. No other screening tool, performance test or demographic were significantly correlated with injury incidence. Previous injuries were not associated with a higher risk of injury but were significantly correlated with the test score of the Counter Movement Jumps both with and without arm swing. Counter Movement Jumps without arm swing were significantly correlated with Counter Movement Jumps with arm swing. No other screening tool or performance test were significantly correlated with other screening tools or performance tests. Results of bivariate analysis of variables that were found to have a significant correlation ($p < .05$) are shown in Table 2.

Table 2
Correlations for tests, demographics and injuries (N = 4)

| | Age | WBLT_R | SLHT_L | CMJ_w | CMJ_wo |
|---|---|---|---|---|---|
| Previous Injuries | | | | .99** | .95* |
| Injury in 2019/20 season | 1.00** | | .96* | | |
| Age | | | .96* | | |
| Height | | .95* | | | |
| Weight | | .97* | | | |
| CMJ_w | | | | | .98* |

*Note* . * Correlation is statistically significant at the .05 level. ** Correlation is statistically significant at the .01 level.
WBLT_R (Weight Bearing Lunge Test - Right) SLHT_L (Single Leg Hop Test for Distance - Left)
CMJ_w (Counter Movement Jump - with arm swing) CMJ_wo (Counter Movement Jump - without arm swing)

## DISCUSSION

A total of eight significant correlations were found in this study as shown in Table 2, however, due to the small sample size, the significance and the practical application of the results is of little to no value. Although statistically significant the correlations found in such a small sample size is likely to form an association that will not exist in a larger scale of the target group. For instance, a significant Pearson´s r of 1.00 was found between age and injury in the 2019/20 season because both participants aged 19 were injured and the other two aged 18 were not. Furthermore, a significant positive Pearson´s r of .96 was found between Single Leg Hop Test for Distance and injury in the 2019/20 season, meaning that those who performed better at this test also were the ones who got injured. This is quite contradictory and serves as a great example of something being statistically significant due to a small sample size but might not always depict the reality of the association, thus preventing the practical application of the results being used.

Undoubtably the greatest limitation to this study presented in the form of the extraordinary situation of COVID-19. Following the AQU guideline (*Agència per a la Qualitat del Sistema Universitari de Catalunya*) of TFM requirements and due to COVID-19 mandatory adaptations, the author of the study was forced to change the original plan of study. A plan of six weeks of prospectively collecting injury data with a baseline test at week zero and a final day of test at week seven during the competitive season was accepted by CER-FCSB the 9th of March 2020. Unlike the COVID-19 adaptation of the study, the tests prepared for the original plan of study were not limited in space nor complexity as the author of the study would be present with the entirety of the team to accurately

collect data from all 20 players as per agreement with the team, bar those that would not meet inclusion and exclusion criteria or simply decline participating in the study. The tests were decided by simplicity and previous application with moderate to significant correlations to risk of injury found in previous studies, and included: Modified Star Excursion Balance Test, Upper Body Y Balance Test, Weight-Bearing Lunge Test, The Four Hop Test Combination (Single Leg Hop for Distance, Triple Hop for Distance, Crossover Hop for Distance, Six-meter One-legged Timed Hop), Counter Movement Jump using MyJump2 App, Apley Scratch Test and T-Test (5,9,15). The prospective period of six weeks would also allow for accurate injury data collection, thus limiting recall bias from participants unable to recall minor injuries during a season. Furthermore, the author of the study would be able to track hours played by each participant thus allowing for an eventual injury incidence being presented by injuries per 1000 player hours. This was not possible in the COVID-19 adaptation of the study.

As only four subjects contributed data to the study any significant correlation found in the statistical analysis would have to be validated by future studies of much larger sample sizes. However, as for descriptive statistics nearly any sample size will suffice. The values determined in the descriptive statistics in this study as seen in Table 1 may be used by future studies for comparative values and contribute to a pool of data for the elite group of high level female youth volleyball players, where there is limited existing evidence for correlation between different data and risk of injury. However, as shown by the Mean ± SD with only four dataset a larger variation in this study still presents, especially in height, weight and the single leg hop tests. Both injuries reported in this study for the 2019/20 season were in the lower extremity, which is also the most reported injured location in volleyball, basketball and handball (3,5,7,8). Demography of age, weight and height found in this study are of comparable values to previous studies (4,6,13). The Counter Movement Jumps results in this study is comparable to that of trained junior athletes using the app MyJump2, however, there is little to no descriptive data presented in homogenous studies about the other tests used in this study (5,6,12,13,20,22). These descriptive values can be used as baseline values and be helpful in

deciding return to play criteria in future injuries. This further underlines the usefulness of the descriptive statistics presented in this study. Apart from presenting descriptive statistics and having a larger sample size, future studies should also follow the participants prospectively over a period of time as this will allow them to determine the injury incidence per 1000 hours and minimise the risk of recall bias. As originally planned for this study it is also recommended that future studies incorporates the tests previously found to be statistically significant in relation to risk of injury, such as the Modified Star Excursion Balance Test and The Four Hop Test Combination (5,9). This will help solidify and validate the significant correlation between these tests and the risk of injury, especially if previous literature focus on similar but not specifically on female youth volleyball.

In conclusion, the results found in this study supports the hypothesis that there is a correlation between injury incidence and tests and demographics in high level female youth volleyball players, however, the results found have no practical application due to a small sample size. As there is limited existing evidence about risk of injury in volleyball, and more specifically high level female youth volleyball, there is certain interest in the descriptive statistics as well as the methodology in this study that contributes to filling the gap of identifying athletes at high risk of developing an injury from validated clinical tests (7,12). This study may contribute to further observational research when evaluating injury risk factors in female youth volleyball such as demographics, screening tools and performance tests through prospective injury surveillance, which previous studies have been requesting (12).

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**ANNEX**

ANNEX 1 - INFORMATION DOCUMENT

Title of study: "*Injury incidence and relationship between screening tools and performance tests in high level youth female volleyball players: An observational study"*
Researcher: Sebastian Åxman, physiotherapist, Danish authorization ID: 0D25R
University: *Blanquerna Universitat Ramon Llull - Máster Universitario en Fisioterapia de los Deportes de Equipo.*

The purpose of this research study is to examine the relationship between player demography (age, height, weight), tests (how far your child reaches, how high and far your child jumps) and the risk of injury. This is information that does not exist today.

We cannot assure you that your child will experience benefits throughout this study, however, by participating in this study your child can help to reduce the amount of future injuries that high level female youth volleyball players suffer. Participating in this study involves:

- Performing and measuring different tests at home
- Approximately 20 minutes duration
- The tests will be done after a 5-minute warm-up

To participate in this study, your child must:

- Be 16-19 years old
- Be a high-level volleyball player
- Actively have participated in team practices and/or matches throughout the 2019-2020 season
- Not have any current injury (unable to participate fully in practices/matches right now, had it been possible to continue the season)

Participation in this study is completely voluntary, your child has the right to decide not to participate, and the right to withdraw at any point if they wish, without

explanation, for the duration of the study. It will be requested that both the participant and their parents or legal guardian sign the revocation document. Withdrawing from this study does not change their relationship with their health care providers or their future care.

Physiotherapist Sebastian Åxman for Barça CVB Femení and author of the study, will explain in detail how to perform and measure all tests. The tests include how far your child can reach with their legs and arms and how far and high they can jump. For the vertical jump tests, video recording by mobile phone is necessary. This recording will not include the face and will only be used for data collection. No other video recording will be made. All the tests are simple and non-aggressive, so the risk of discomfort is low when following the researcher´s instructions. IMPORTANT: Your child´s results will be anonymised with a code, and they will at no point during or after this study be able to get identified from it. The data will be stored at a password-protected external hard-drive only accessible to the main researcher.

Apart from the tests your child will be provided with a printed-out injury questionnaire to fill out about their injury history in the 2019-2020 season. The questionnaire will contain questions about where they got injured, how they got injured and if the injury happened during time of menstruation.

We can then analyze if there is a connection between your child´s test results and if they got injured or not. This information will help us lower the risk of injury for high-level youth female volleyball players in the future.

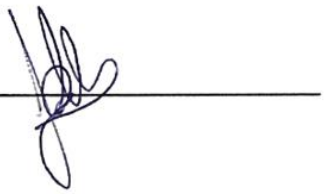
In case of doubt or questions regarding the research study, or any other question it has raised, you and/or your child can contact the main investigator of the project, Sebastian Åxman, by email: sebastiana@blanquerna.url.edu

ANNEX 2 - PERMISSION OF THE CLUB

Injury incidence and relationship between screening tools and performance tests in high level youth female volleyball players: An observational longitudinal study

I, Adrián Florenzo Pavón, as head coach of Barça Femení CVB Júvenil A, hereby confirm that physiotherapist Sebastian Åxman has permission to do his study *Injury incidence and relationship between screening tools and performance tests in high level youth female volleyball players: An observational study* with Barça Femení CVB Júvenil A.

The study period will be six weeks, with two separate days of tests, one in the beginning (week 0), and one at the end of the study (week 6). In collaboration with Barça CVB this study aims to reduce the amount of future injuries that high level female youth volleyball players get by investigating different risk factors.

Date 28.02.2020 Signature 

ANNEX 3 - RESEARCH ETHICS COMMITTEE (CER-FCSB) - APPROVED

Blanquerna
UNIVERSITAT RAMON LLULL
Facultat de Ciències de la Salut

**Revalorització del Dictamen CER-FCSB sobre el TFM nº2020-02-21 de l'alumne:**
**Sebastian Åxman**
**tutoritzat per: Miriam Guerra Balic**

Revalorització el TFM de títol: Injury incidence and relationship between screening tools and performance tests in high level youth female volleyball players: An observational longitudinal study

s'aprova per part del CER-FCSB en sessió de 20 d'abril del 2020

ANNEX 4 - INFORMED CONSENT - PARTICIPANT

*Check all the boxes*

- I confirm that I have read the information document as a participant in this research study "*Injury incidence and relationship between screening tools and performance tests in high level youth female volleyball players: An observational study"* by main researcher Sebastian Åxman, as well as this informed consent sheet. ☐

- I understand that I am not required to participate in this study and that I can withdraw at any time without having to give any explanation why. ☐

- I have been informed that I may feel tired or with some kind of discomfort during the evaluations, but these discomforts will disappear. ☐

- I understand that the information obtained will be entered into a database for further computer analysis and will be treated in a strictly confidential manner. ☐

- I understand that I will not be, under any circumstances, identified in the final study report. ☐

- I confirm that I have understood the information received and that I agree to participate in this study. ☐

…….. ……

Name DNI

…….. ……

Date of Birth Date

…….. ……..

Participant´s signature Main researcher´s signature

ANNEX 5 - INFORMED CONSENT – PARENT OR LEGAL GUARDIAN

*Check all the boxes*

- I confirm that I have read the information document as a parent or legal guardian in this research study "*Injury incidence and relationship between screening tools and performance tests in high level youth female volleyball players: An observational study"* by main researcher Sebastian Åxman, as well as this informed consent sheet. ☐

- I understand that my child is not required to participate in this study and that they can withdraw at any time without having to give any explanation why. ☐

- I have been informed that my child may feel tired or with some kind of discomfort during the evaluations, but these discomforts will disappear. ☐

- I understand that the information obtained will be entered into a database for further computer analysis and will be treated in a strictly confidential manner. ☐

- I understand that my child will not be, under any circumstances, identified in the final study report. ☐

- I confirm that I have understood the information received and both my child and I agree for my child to participate in this study. ☐

…….. ……

Child´s name DNI

…….. ……

Child´s Date of Birth Date

…….. ……..

Parent or Legal Guardian´s signature Main researcher´s signature

ANNEX 6 - REVOCATION DOCUMENT

Participant name: _____

Participant DNI: _____

Team affiliation: _____

Main researcher: _____

Study title: _____

_____

*Check all the boxes*

- I am requesting to discontinue my participation in the research study noted above. ☐

- I understand the research team may continue to use my information that has already been collected prior to my revocation in order to maintain the integrity or reliability of the research. ☐

- I understand that withdrawing from this study does not change my relationship with my health care providers or my future care. ☐

…….. ……..

Participant´s signature Main researcher´s signature

…… …..……..

Parent or Legal Guardian´s signature (if applicable) Date

## ANNEX 7 - PERFORM & MEASURE TESTS

Make sure to read and understand the description below for each point in this 3-step procedure:

1. Warm-up
2. Perform and measure the tests
3. Write down results immediately after measuring each time

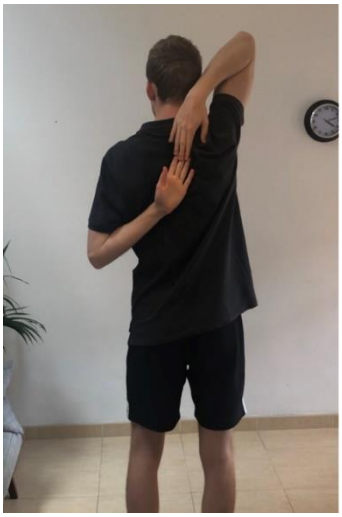
1. **Warm-up (5-10 min)**

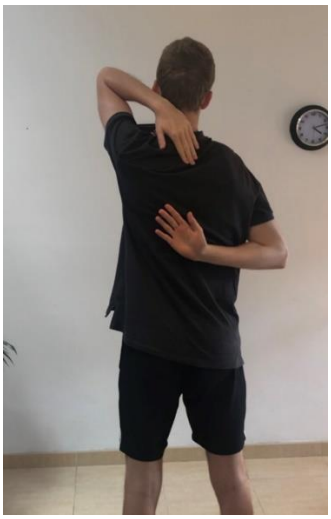
- Jogging in place or jumping rope (30 seconds)
- Jumping jacks (30 seconds)
- Burpees (10 repetitions)
- Squats (10 repetitions)
- Lunges (10 repetitions)

2. **Tests (15-20 min)**

**Apley Scratch Test**

**Perform:** Stand and raise one arm above your head and bend at the elbow to reach behind your head. The other arm will fall at your side and reach up behind your back. Try to touch your hands together in the centre of your back.
**Measure:** If the hands do not touch, measure the shortest distance between them. If they touch note down 0 cm. Lower arm is the test-side when you write your results. Repeat for both sides.





**Weight-Bearing Lunge Test**

**Perform:** Place your test foot perpendicular to the wall and lunge forward so the knee touches the wall. The heel should not be lifted off from the floor, if it does the test does not count and you must repeat. Move further away until the knee can only make slight contact with the wall with heel and foot flat on the ground. Perform test without shoes.
**Measure:** Closest distance from toes to wall. Repeat for both sides.

**Single Leg Hop Test for Distance**

**Perform:** Stand on testing leg with your toes on the starting line and hop as far forward as possible and land on the same leg. Stick and hold the landing position with control and minimal body sway for a minimum of three seconds. If you move your foot when landing to keep balance, the test does not count and you will must repeat. Perform three practice hops on each leg, then flip a coin to decide the starting leg. Perform three valid hops on each side.

**Measure:** Distance from starting line to the heel of the landing foot.

**Counter Movement Jump – Without arm swing (Video)**

**Perform:** Stand with feet equal to the width of the shoulders, knees straight, trunk fully upright and hands fixated on hips. Perform a fast flexion of the legs (mini-squat) and immediately after perform the explosive vertical jump. Land with straight legs and keep hands fixated on hips at all times. If you land with bend legs or use arm movement during the jump, the test does not count and you must repeat. Perform three practice jumps before performing three valid jumps of maximal effort.

**Measure:** Film your three jumps (use smartphone or video camera) from chest down, no face. Make sure the feet and the ground are clearly visible. If possible, film in slow motion.

**Counter Movement Jump – With arm swing (Video)**

**Perform:** Stand with feet equal to the width of the shoulders, knees straight, trunk fully upright and arms out wide. Perform a fast flexion of the legs (mini-squat) and immediately after perform the explosive vertical jump and with the elbows flexing and hands going up to the face. Land with straight legs. If you land with bend legs the test does not count and you must repeat. Perform three practice jumps before performing three valid jumps of maximal effort.
**Measure:** Film your three jumps (use smartphone or video camera) from chest down, no face. Make sure the feet and the ground are clearly visible. If possible, film in slow motion.

3. **Results**

| Name: | | |
|---|---|---|
| Date: | | |
| **Test** | **Left (cm)** | **Right (cm)** |
| Apley Scratch Test | | |
| Weight-Bearing Lunge Test | | |
| Single Leg Hop Test | Test 1: | Test 1: |
| | Test 2: | Test 2: |
| | Test 3: | Test 3: |

*For test results of Counter Movement Jump with and without arm swing, simply attach the videos to the mail.

Send both your results from the scheme above and the attached videos to the author of this study, Sebastian Åxman, to mail: sebastiana@blanquerna.url.edu

ANNEX 8 - DATA COLLECTION

Participant name: _____

Team affiliation _____

Date _____

Date of birth _____

Height (cm)_____

Weight (kg) _____

Previous injuries (before the 2019-2020 season): ☐ YES ☐ NO

If yes, please specify:

_____

_____

_____

_____

---

Have you suffered any injuries in the 2019-2020 season? ☐ YES ☐ NO

If yes, please specify in the following questions by marking the correct box with an X. An injury is defined as not being unable to participate in practice and/or match play due to the discomfort caused from the injury.

*In case of multiple injuries mark the correct boxes with numbers (1,2,3…), and use the same number for each individual injury.

1. What part of your body was injured?

☐ head ☐ face ☐ finger(s) ☐ hand ☐ elbow

☐ shoulder ☐ chest ☐ back ☐ hip ☐ groin

☐ thigh ☐ knee ☐ lower leg ☐ ankle ☐ foot

other body region _____

2. Injury location: ☐ right side ☐ left side ☐ bilateral

3. Could you complete the training session/match play? ☐ YES ☐ NO

4. For how long were you unable to participate in practice and/or match play due to injury?

☐ 0 days ☐ 1-3 days

☐ 4-7 days ☐ 8-28 days

☐ >28 days

5. At which point did you get injured?

☐ during training ☐ during warm-up before match

☐ 1st or 2nd set ☐ 3rd set ☐ 4th or 5th set

☐ the injury occurred gradually

other _____

6. In what kind of situation did you get injured?

☐ blocking ☐ spiking ☐ serving

☐ setting ☐ do not know

other _____

7. Were you in contact with another player when you got injured? ☐ YES ☐ NO

8. Did the injury happen during time of menstruation? ☐ YES ☐ NO