






Information Sheet for Participants

Title – Effects of maturation and sex on biomechanics pertaining to ACL injury

Aim – Investigate the differences in biomechanical and neuromuscular measures pertaining to ACL injury within groups of different defined maturational phases and sex.

Background – Anterior cruciate ligament (ACL) injuries are common amongst young athletes and are observed most often between 15-25 years old. Previous research has suggested differences in movement techniques between males and females from 12 years old and further changes throughout maturation. Risk of potential ACL injury can be assessed using tasks involving landing and jumping in different directions and balancing. We want to better understand the movement changes that occur in males and females of different maturational phases and to determine when and how increased risk of ACL injury may be apparent. This information is important for development of effective ACL injury prevention programmes, techniques, or devices.

Overview – Should you agree to participate, you will be asked to sign an informed consent form, complete a baseline questionnaire, a menstrual cycle questionnaire (females only) and a maturational phase questionnaire. You will be required to attend a minimum of one and a maximum of two sessions (should you wish to participate in the reliability portion of the study) at the Adams Centre for High Performance Sport. You will be asked to perform four tasks involving dropping from a 30 cm box; 1) onto one foot 2) onto one foot and then hopping as high as you can 3) onto one foot and then hopping sideways onto your other foot 4) turning 90° in the air before landing and then hopping as high as you can. Following this, you will be asked to perform a single leg squat task to test balance, a go/no-go task to test reaction time, and a single leg hop task to test stiffness. Force plates, 3D cameras, 2D cameras, and Inertial measurement units will be used to track your movements and collect data. Each session should last 80 – 90 minutes.

Technology	Description	Picture
Questionnaires	Paper-based or tablet-based recording of participant information, physical activity, maturational phase identification, menstrual cycle related information.	
Cognitive tasks	Paper-based, computer-based, or tablet-based recording of cognitive function	
3D video recordings (Qualisys Track Manager software and cameras)	Monitors 3D biomechanics with use of retro-reflective markers adhered using double-sided tape and topical skin adhesive.	
Force plates (Kistler)	Monitors temporal and kinetic information (i.e., contact time, force applied to ground, shifting of weight during balancing).	
Inertial measurement units (IMU)	Wearable devices that measure acceleration in three planes of motion.	

What are the potential risks – The risks associated with participating in this study are no greater than those associated with training or playing in any court or field sport. Although the injury risks are considered minimal, we cannot guarantee your safety. If accidental harm does occur during study participation, the research team will offer immediate first aid and support you in accessing medical attention as required. If an accidental injury does happen during testing, costs of injury treatment are likely to be covered – at least in part – by Accident Compensation Corporation.

What will happen to the information collected – The information collected will be used by the research team to write research reports, give scientific presentations, help in educating students at the University of Waikato and the wider community and contribute to a PhD Thesis. Only the research team and a small number of research associates who have signed a non-disclosure agreement will have direct access to the notes, documents, and recordings. At the end of the project, any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which they will be destroyed. All data will be treated with the strictest confidentiality. No participants will be named in the publications and every effort will be made to disguise your identity. No videos or images will be published or presented in a way that allows your identification (i.e., your face will be concealed to protect your identity) unless you provide written informed consent to having them used without alterations. All data used in teaching will be de-identified (i.e., will not contain your personal information) to protect your identity and confidentiality.

Declaration to participants – If you take part in the study, you have the right to:

- Ask any further questions about the study that occurs to you during your participation.
- A summary of findings from the study when it is concluded.
- Have a support person (family, whanau, and/or friend) present during your participation.
- Refuse to answer any particular question, and to withdraw from the study at any time without giving a reason.
- Withdraw any information provided at any point during or up to two weeks after participating in the research activities by contacting the primary investigator.

Who is responsible – If you have any questions about the project, please feel free to contact:

Anna Butcher (**Primary Investigator**)

The University of Waikato, Adams Centre for High Performance

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Kim Hebert-Losier (**Primary Supervisor**)

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Human Research Ethics Committee – This research project has been approved by the Human Research Ethics Committee (Health) of the University of Waikato under *HREC(Health)#2022-53*.

Any questions about the ethical conduct of this research should be directed to Primary Investigator in a first instance. Any residual concerns may be addressed to the Secretary of the Committee, email humanethics@waikato.ac.nz, postal address, University of Waikato, Te Whare Wananga o Waikato, Private Bag 3105, Hamilton 3240.






Information Sheet for Participants (Child specific)

Title – Effects of maturation and sex on biomechanics pertaining to ACL injury

Aim – Are there differences in movements between different maturational groups and between boys and girls?

Background – Anterior cruciate ligament (ACL) knee injuries are common amongst young athletes and often happen between 15-25 years old. The risk of someone getting this injury can be checked using landing, jumping, and balancing tests. We want to better understand the movement changes in boys and girls as they mature to check for when and how risk of injury might be higher. Once we know this, we can develop better injury prevention programmes, techniques, or devices.

Overview – If you agree to participate, you will need to sign an informed consent form, complete a baseline questionnaire, a menstrual cycle questionnaire (females only), and a maturational phase questionnaire. You will need to attend a minimum of one and a maximum of two sessions (if you wish to participate in the reliability portion of the study) at the Adams Centre for High Performance Sport. You will be asked to perform four tasks where you will drop from a small 30 cm box; 1) onto one foot 2) onto one foot and then hopping as high as you can 3) onto one foot and then hopping sideways onto your other foot 4) onto one foot after turning 90° in the air. Afterwards, you will do a single leg squat task to test your balance. Force plates and 3D cameras will be used to track your movements and collect data. Each session should last 80 – 90 minutes.

Technology	Description	Picture
Questionnaires	Paper-based or tablet-based recording of participant information, physical activity, maturational phase identification, menstrual cycle related information.	
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What are the potential risks – The risks associated with participating in this study are no greater than those associated with training or playing in any court or field sport. Although the injury risks are considered minimal, we cannot guarantee your safety. If accidental harm does occur during study participation, the research team will offer immediate first aid and support you in accessing medical attention as required. If an accidental injury does happen

during testing, costs of injury treatment are likely to be covered – at least in part – by Accident Compensation Corporation.

What will happen to the information collected – The information collected will be used by the research team to write research reports, give scientific presentations, help in educating students at the University of Waikato and the wider community and contribute to a PhD Thesis. Only the research team and a small number of research associates who have signed a non-disclosure agreement will have direct access to the notes, documents, and recordings. At the end of the project, any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which they will be destroyed. All data will be treated with the strictest confidentiality. No participants will be named in the publications and every effort will be made to disguise your identity. No videos or images will be published or presented in a way that allows your identification (i.e., your face will be concealed to protect your identity) unless you provide written informed consent to having them used without alterations. All data used in teaching will be de-identified (i.e., will not contain your personal information) to protect your identity and confidentiality.

Declaration to participants – If you take part in the study, you have the right to:

- Ask any questions whenever you like.
- Know what we found out from the study at the end.
- Have a support person (family, whanau, and/or friend) there when you participate.
- Refuse to answer any questions you don't want to and leave the study at any time without giving a reason.
- Take back any information provided at any point during or up to two weeks after your participation by telling the primary investigator.

Who is responsible – If you have any questions about the project, please feel free to contact:

Anna Butcher (**Primary Investigator**)

The University of Waikato, Adams Centre for High Performance
52 Miro Street, Mount Maunganui 3116

annaibutcher@gmail.com

Kim Hebert-Losier (**Primary Supervisor**)

The University of Waikato, Adams Centre for High Performance
52 Miro Street, Mount Maunganui 3116

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Any questions about the ethical conduct of this research should be directed to Primary Investigator in a first instance. Any residual concerns may be addressed to the Secretary of the Committee, email humanethics@waikato.ac.nz, postal address, University of Waikato, Te Whare Wananga o Waikato, Private Bag 3105, Hamilton 3240.

Consent Form for Participants



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Te Whare Wānanga o Waikato

Title – Effects of maturation on biomechanics pertaining to ACL injury

I have read the Participant Information Sheet for this study and have had the details of the study explained to me. My questions about the study have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I understand that any data, information, or answers will remain confidential in regard to my identity through a coding system. The data will be made publishable, so every effort will be made to ensure confidentiality and anonymity, however, anonymity cannot be guaranteed.

I understand that any video or images taken during the testing sessions may allow me to be identified. I can choose to consent to the use of videos and images in their original form for the use of publications, presentations, reports, marketing/promotion, or educational material. I understand that if I do not provide consent, videos and images may be used in an altered form, where the face will be concealed to de-identify the media if used in publications, presentations, reports, marketing/promotion, or educational material.

I also understand that:

- *I am free to withdraw from the study at any time or to decline to answer any particular questions.*
- *I can withdraw any information I have provided up to two weeks after participating in the research activities by contacting the primary investigator.*
- *Any data or answers will remain confidential in regards to my identity through a coding system.*
- *The data might be published, so every effort will be made to ensure confidentiality.*

I agree to provide information to the researchers under the conditions of confidentiality set out on the Participant Information Sheet.

Consent to Participate

I agree to participate in this study under the conditions set out in the Participant Information Sheet.

	Participant:	Proxy (if participant < 16 y):	Researcher:
Signature:	_____	_____	_____
Name:	_____	_____	_____
Date:	_____	_____	_____

Additional Consent (Optional)

I agree to my images and videos being used in their original (unaltered) form for publication, scientific presentation, and/or education purposes.

	Participant:	Proxy (if participant < 16 y):	Researcher:
Signature:	_____	_____	_____
Name:	_____	_____	_____
Date:	_____	_____	_____



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Participant Data Collection Sheet



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Title – Effects of maturation on biomechanics pertaining to ACL injury

TEST DAY, TIME, LOCATION		ID NUMBER	
GENERAL			
NAME			
DATE OF BIRTH (dd /mm/yyyy)			
BIOLOGICAL SEX AT BIRTH (please tick)	<input type="checkbox"/> MALE <input type="checkbox"/> FEMALE		
HEIGHT (cm)		MASS (kg)	
SEATED HEIGHT (cm)		PARENTS HEIGHT (cm)	Mother Father
ETHNICITY			
WHICH LEG WOULD YOU KICK A BALL WITH?			
E-MAIL (for post-study information)			
ARE YOU IN GOOD GENERAL HEALTH?	<input type="checkbox"/> YES <input type="checkbox"/> NO		
DO YOU HAVE ANY CURRENT OR RECENT (less than 3 months) INJURIES? If yes, please provide detail	<input type="checkbox"/> YES <input type="checkbox"/> NO		

ID NUMBER	
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We are trying to find out about your level of **physical activity**

Remember:

- ✓ There are no right and wrong answers — this is not a test.
- ✓ Please answer all the questions as honestly and accurately as you can — this is very important.
- ✓ Answer all 8 questions.

QUESTION 1.

During the past **12 months** (year), how much do you move and exert yourself physically during leisure/play time? If your activity varies greatly during the year (for example, between summer and winter) try to estimate overall. Tick **one** answer only.

- ☐ Hardly any physical activity (reading, watching TV, using the computer)
- ☐ Mostly sitting, sometimes walk, easy tasks/play
- ☐ Light physical activity for about 2 – 4 hours a week, like fishing, talking, dancing
- ☐ Moderate exercise 1 – 2 hours a week, like jogging, swimming, gymnastics
- ☐ Moderate exercise at least 3 hours a week, like jogging, swimming, gymnastics
- ☐ Hard or very hard exercise regularly and several times a week, during which the physical exercise is great, like jogging, rugby, football.

QUESTION 2.

During the past **12 months** (year), on how many sports teams did you play? Tick **one** answer only.

Count any teams run by your school or community groups.

- ☐ 0 teams
- ☐ 1 team
- ☐ 2 teams
- ☐ 3 teams or more

QUESTION 3.

During the past **7 days**, on how many days were you physically active for a total of **at least 60 minutes per day**? Tick **one** answer only.

Add up all the time you spent in any kind of physical activity that increased your heart rate and made you breathe hard some of the time

☐ 0 days

☐ 1 day

☐ 2 days

☐ 3 days

☐ 4 days

☐ 5 days

☐ 6 days

☐ 7 days

QUESTION 4.

During the past **7 days**, on how many days did you do exercises **to strengthen or tone your muscles**, such as push-ups, sit-ups, or weightlifting? Tick **one** answer only.

☐ 0 days

☐ 1 day

☐ 2 days

☐ 3 days

☐ 4 days

☐ 5 days

☐ 6 days

☐ 7 days

QUESTION 5.

On an average **week day**, how many hours do you watch TV? Tick **one** answer only.

☐ I do not watch TV on an average school day

☐ Less than 1 hour per day

☐

1 hour

☐

2 hours

☐

3 hours

☐

4 hours

☐

5 hours

☐

More than 5 hours per day

QUESTION 6.

On an average **week** day, how many hours do you play video or computer games or use a computer for something that is not school/ work related? Tick **one** answer only.

Count time spent playing games, watching videos, texting, or using social media on your smartphone, computer, Xbox, PlayStation, iPad, or other tablet.

☐

I do not play video or computer games or use a computer for something that is not school/ work

☐

Less than 1 hour per day

☐

1 hour

☐

2 hours

☐

3 hours

☐

4 hours

☐

5 hours

☐

More than 5 hours per day

QUESTION 7.

If you go to school, in an average school week, on how many days do you go to physical education (PE) classes?

☐

0 days

☐

1 day

☐ 2 days

☐ 3 days

☐ 4 days

☐ 5 days

QUESTION 8

During the past **7 days**, please tell us how much time you have spent in each category of activity.

- ✓ Vigorous physical activities require hard physical effort and make you breath much harder than normal
- ✓ Moderate activities take moderate physical effort or make you breathe somewhat harder than normal
- ✓ Walking includes at work, at school, and at home, walking from place to place, and any other walking that you have done for recreation, sport, exercise, or leisure/fun
- ✓ Sitting includes time spent sitting at work, at school and at home, while doing some course work and leisure/play time. This may include time spend sitting at a desk, visiting friends, reading, or sitting or lying down to watch TV.

How much time do you usually spend doing this activity?			
Activity	Days per week?	Hours per day?	Minutes per day?
Vigorous			
Moderate			
Walking			
Sitting			



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Modified Pubertal Maturation Observational Scale (PMOS)

ID NUMBER	
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Female Characteristic Checklist

- _____ The adolescent has grown 3 to 3.5 inches in the past 6 months or is past this growth spurt.
- _____ The adolescent has begun breast development.
- _____ The adolescent has begun menarche.
- _____ The adolescent has evidence of darker underarm hair or shaves.
- _____ The adolescent has evidence of darker hair on her legs or shaves.
- _____ The adolescent's calves are becoming defined.
- _____ The adolescent has evidence of acne.
- _____ There was evidence of sweating after physical activities.

Male Characteristic Checklist

- _____ The adolescent has evidence of darkening of facial hair or shaves.
- _____ The adolescent's voice has gotten deeper or is currently breaking.
- _____ The adolescent has grown 3 to 4 inches in the past 6 months or is past the growth spurt.
- _____ The adolescent has darker hair on his legs.
- _____ The adolescent's biceps are becoming defined.
- _____ The adolescent's calves are becoming defined.
- _____ The adolescent has evidence of acne.
- _____ There was evidence of sweating after physical activities.
- _____ There is darkened underarm hair.

KEY:

+ characteristic is present

- characteristic is absent

SCORING CRITERIA FOR MALES AND FEMALES

STAGES NUMBER OF "+"

Prepuberty 1 or less

Mid-pubertal 4 or 5; growth spurt essential

Post-pubertal at least 6; growth spurt completed

Please circle the pubertal stage which most closely represents the participant currently.

The Tanner Stages

Because the onset and progression of puberty are so variable, Tanner has proposed a scale, now uniformly accepted, to describe the onset and progression of pubertal changes (Fig. 9-24). Boys and girls are rated on a 5 point scale. Boys are rated for genital development and pubic hair growth, and girls are rated for breast development and pubic hair growth.

Pubic hair growth in females is staged as follows (Fig 9-24, B):

- **Stage I (Preadolescent)** - Vellos hair develops over the pubes in a manner not greater than that over the anterior wall. There is no sexual hair.
- **Stage II** - Sparse, long, pigmented, downy hair, which is straight or only slightly curled, appears. These hairs are seen mainly along the labia. This stage is difficult to quantitate on black and white photographs, particularly when pictures are of fair-haired subjects.
- **Stage III** - Considerably darker, coarser, and curlier sexual hair appears. The hair has now spread sparsely over the junction of the pubes.
- **Stage IV** - The hair distribution is adult in type but decreased in total quantity. There is no spread to the medial surface of the thighs.
- **Stage V** - Hair is adult in quantity and type and appears to have an inverse triangle of the classically feminine type. There is spread to the medial surface of the thighs but not above the base of the inverse triangle.

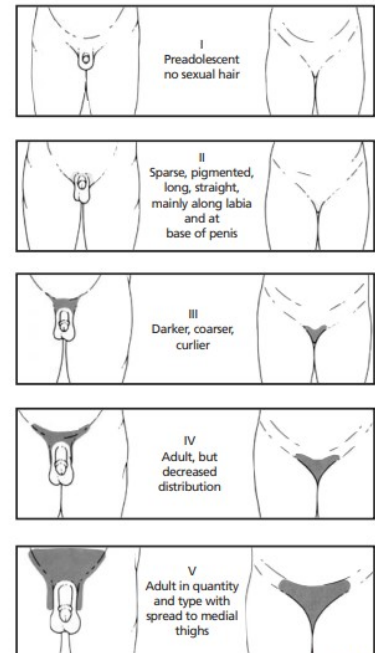


Fig. 9-24, B

The stages in male pubic hair development are as follows (Fig. 9-24, B):

- **Stage I (Preadolescent)** - Vellos hair appears over the pubes with a degree of development similar to that over the abdominal wall. There is no androgen-sensitive pubic hair.
- **Stage II** - There is sparse development of long pigmented downy hair, which is only slightly curled or straight. The hair is seen chiefly at the base of penis. This stage may be difficult to evaluate on a photograph, especially if the subject has fair hair.
- **Stage III** - The pubic hair is considerably darker, coarser, and curlier. The distribution is now spread over the junction of the pubes, and at this point that hair may be recognized easily on black and white photographs.
- **Stage IV** - The hair distribution is now adult in type but still is considerably less than seen in adults. There is no spread to the medial surface of the thighs.
- **Stage V** - Hair distribution is adult in quantity and type and is described in the inverse triangle. There can be spread to the medial surface of the thighs.

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In young women, the Tanner stages for breast development are as follows (Fig. 9-24, C):

- **Stage I (Preadolescent)** - Only the papilla is elevated above the level of the chest wall.
- **Stage II - (Breast Budding)** - Elevation of the breasts and papillae may occur as small mounds along with some increased diameter of the areolae.
- **Stage III** - The breasts and areolae continue to enlarge, although they show no separation of contour.
- **Stage IV** - The areolae and papillae elevate above the level of the breasts and form secondary mounds with further development of the overall breast tissue.
- **Stage V** - Mature female breasts have developed. The papillae may extend slightly above the contour of the breasts as the result of the recession of the areolae.

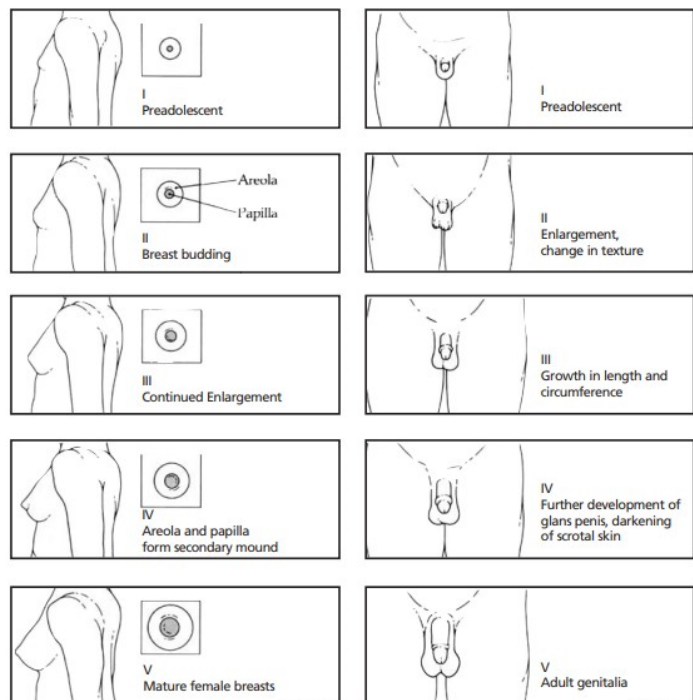


Fig. 9-24, C

The stages for male genitalia development are as follows: (Fig. 9-24, A):

- **Stage I (Preadolescent)** - The testes, scrotal sac, and penis have a size and proportion similar to those seen in early childhood.
- **Stage II** - There is enlargement of the scrotum and testes and a change in the texture of the scrotal skin. The scrotal skin may also be reddened, a finding not obvious when viewed on a black and white photograph.
- **Stage III** - Further growth of the penis has occurred, initially in length, although with some increase in circumference. There also is increased growth of the testes and scrotum.
- **Stage IV** - The penis is significantly enlarged in length and circumference, with further development of the glans penis. The testes and scrotum continue to enlarge, and there is distinct darkening of the scrotal skin. This is difficult to evaluate on a black-and-white photograph.
- **Stage V** - The genitalia are adult with regard to size and shape.

Fig. 9-24, A

Menstrual cycle questionnaire

ID NUMBER	
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1. Have you begun menstruating? Yes/ No (If the answer is no, you will not need to fill in the remainder of the survey)
2. At what age did you begin menstruation?
3. Do you currently experience menstruation every month?
4. Are you currently using any form of contraceptive? If so, please state which and how long for.
5. Have you used any form of contraception in the past?
6. Do you ever experience unexpected, missed periods or an extended time (>40 days) between periods? Yes/ No
7. If yes, does this happen on a regular basis? If so, please provide details as to how regularly. (If your answer to question 6 was no, skip this question).
8. Have you ever tracked your cycle through the use of an app or diary? Yes/ No
9. Do you have any medical conditions? If so, please specify.
10. Are you currently taking, or have you recently (within the past 6 months) been taking any form of medication? If so, please specify.
11. What was the date of the first day of your most recent period?