

Are YOU Tough Enough?

Can a Varsity Basketball Skill-set Translate to Success in American Ninja Warrior?

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Introduction

The target population of interest are three athletes each from both the 2018/2019 Varsity University of Victoria's Men's and Women's Basketball Teams. In the proposed test battery, the physiological and physical fitness levels of the participants will be tested, and it will be determined if the participants can compete in the popular NBC entertainment competition and television show American Ninja Warrior (ANW). Based on a Japanese television series called Sasuke, ANW first aired in 2009 and is primarily filmed in Los Angeles, California. 100 aspiring applicants must first be selected by producers to appear in the regional qualifiers. In order to advance through the regional qualifier stage, which is composed of six obstacles, participants must finish in the fastest 30 times. These individuals advance to city finals, which is composed of six completely different obstacles. The fastest 15 finishers then appear in the National Finals, which is composed of four stages for a chance to win cash prizes and be crowned the winner of American Ninja Warrior.

Contestants in American Ninja Warrior need to have high levels of health and skill-related components of fitness including muscular strength and endurance, explosive power, and cardiorespiratory endurance (Bruno & Farrell, 2017). Given that obstacles on American Ninja Warrior are designed to be completed within 10-15 seconds, athletes are relying primarily on anaerobic contributions during each individual obstacle (Gastin, 2001). However, each round of American Ninja Warrior features multiple obstacles, and the rounds are upwards of 90 seconds which results in athletes also relying on their aerobic energy system (Gastin, 2001). The nature of the ANW obstacles places a strong emphasis on body weight and callisthenic type movements. Therefore, this will be including this as a significant portion of our test battery.

To be successful at American Ninja Warrior, contestants also must have high levels of upper-body strength and grip strength. Many of the obstacles require contestants to hang suspended from the arms using the hands in a variety of different grip positions, while also being able to manipulate their own body weight in the air (Greenfield, 2014). Contestants also must be able to hold themselves up in awkward positions and extend their limbs out to the limits of its range of motion, so having high levels of flexibility is also necessary for an American Ninja Warrior contestant (Greenfield, 2014). Finally, many obstacles require contestants to run and jump across uneven or slippery surfaces, so agility and deft footwork is also a high priority for contestants (Greenfield, 2014).

The average size of successful contestants is 172 centimetres and 70 kilograms (Seabaugh, 2017). Of course, there are a range of successful competitors but this small to average size allows for increased control due to a lower center of gravity and a larger strength-to-weight ratio to carry them through the already demanding course. This will be a challenge that our test subjects will need to overcome as most of them are above average in terms of height. For the purpose of evaluating participants through our test battery, a focus will be placed upon these skills that we believe to be important to be successful at ANW. While our target population is clearly skilled at their primary sport of basketball, it will be interesting to see if their acquired basketball skills translate well to ANW.

Methods

Table 1.

The Battery Test Summary

Approximate Duration per Participant (min)	Tests Selected	Construct Measured
5	Medical History and Consent Forms	Subject physical history, Precautions and potential contraindications
5	Resting Heart Rate and Blood Pressure	Baseline testing and precautions
5	Wing Span, Height and Weight	Anthropometric Measurements
5	Sit and Reach	Flexibility
5	Vertical Jump	Lower extremity power output
5	Grip Strength	Overall muscle strength
5	Max Repetition Pull Ups	Upper body strength
5	Shoulder ROM	Shoulder flexibility
5	Max Hang Time	Upper body endurance
5	70 m Obstacle Course	Agility
5	Queen's Step Test	Aerobic Fitness

Equipment

- Heart Rate Monitor

- Sphygmomanometer and stethoscope
- Tape measure (at least 2.5 m)
- Electronic scale
- Flexometer
- Vertec - vertical jump measurement tool
- Grip Strength Dynamometer
- Pull up bar
- Flat wall surface
- Stair or step that is 16 ¼ inches
- Pen and paper for recording data
- 400m track
- Stop watch
- 5 training cones
- 6 foam rings
- 1 box (box jumps - 24-30 inches)
- Access to rock climbing wall
- Ruler
- Goniometer Pro Version 2.7
- Performance recording sheets

Due to scheduling conflicts and time constraints, testing will be done over a period of several weeks and multiple sessions. No specific order of testing will be followed, and recovery time will not be kept constant between each test. When recruiting participants, the only inclusion

criteria was for the participant to be a member of the University of Victoria varsity basketball program.

Anthropometric Measurements

Height measurement

Required Equipment: Flat wall surface, ruler, tape measure, pen and paper for recording data

Protocol: Have the subject stand flat against vertical wall with heels touching wall and feet together. Ask subject to remove footwear and headwear. Place the tape measure against the wall and ensure it is level (perpendicular with the wall). Ask the subject to place their arms by their side and look straight ahead. Check that the subject's feet are flat against the floor. Adjust the ruler segment of the apparatus on top of the subject's head, making sure to decompress any hair in order to ensure contact with the head. While the subject takes a deep breath in, mark the ruler height on the vertical wall. Check that the lower border of the ruler matches the ruler mark. Make sure to record the distance between the ruler mark and the floor to the nearest 0.5 cm (CSEP, 2013). The recorded value will be rounded to the nearest 0.5 cm.

Weight measurement

Required Equipment: Electronic Scale, pen and paper for recording data

Protocol: Before instructing the subject to step on the scale, ensure they remove extra, heavy layers of clothing (i.e. jackets, headwear, footwear - socks are ok). Place the scale on a flat, dense and smooth surface, in order to avoid discrepancies in measurements. Ask the subject to step onto the scale with equal weight distribution (i.e. feet separated equally from the center of the scale). Make sure to record the weight in kilograms to the nearest 0.5 kg. Instruct the subject to step off of the device and inform them that the test has finished.

Wingspan measurement

Required Equipment: Ruler or tape measurement, tape, vertical wall, pen and paper.

Protocol: Instruct the subject to stand against the vertical wall with their arms stretched out horizontally at a 90-degree angle to the body. To help the subject maintain maximal horizontal stretched arms, tape markers can be placed on the walls for visual cues. Wingspan is measured from the tip of the longest finger to the tip of the other. The wingspan recording will be rounded to the nearest 0.5 cm.

Why we chose to measure wingspan: In order to contest to be an ANW one must have certain anthropometric requirements. A greater wingspan will help the subjects throughout the ANW obstacle courses for reaching certain targets, however a shorter wingspan could also benefit for less of a distance to travel when pulling the body up during movements.

Resting Heart Rate and Blood Pressure

Resting heart rate (HR) is an important measure of general cardiovascular health and suggestion of how the body may respond to exercise. Resting HR should be less than 100 bpm. To ensure accuracy and precision, both a HR monitor and the manual method should be used. Additionally, resting blood pressure (BP) should be taken before testing begins. Resting BP should be less than 160 mmHg systolic pressure and less than 90 mmHg for diastolic pressure. These measurements allow for baseline data to be recorded and analyzed in terms of cardiovascular fitness and exertion.

Protocol for resting heart rate (manual)

Have the subject sit comfortably, feet placed flat on the ground, left arm outstretched in a relaxed position on a level surface just below shoulder height. Find the subjects radial pulse or carotid pulse by placing one or two fingertips gently over the respective arteries. For resting

measurements make sure to begin your count at zero, once the pulse has been found. Count the number of beats in a 15 second interval. Multiply by four to find beats per minute. Resting heart rate will be measured as a whole number.

Protocol for resting blood pressure

Make sure the sphygmomanometer is the correct size for the subject. Instruct the subject to sit comfortably, feet flat on the ground and about shoulder width apart. Have the subject rest their left arm comfortably on a counter height surface. Instruct the subject to not speak and to relax. Inform the subject of the purpose of the test and ask their permission to touch their arm and shoulder. Place the sphygmomanometer on their upper arm and align it with their brachial artery. Find the radial pulse. Quickly inflate the sphygmomanometer to around 20 mmHg above the mark where the subject's radial pulse is no longer detected. Place the stethoscope end over the brachial artery and hold the subject's arm so they are fully relaxed. Carefully and slowly release the cuff (~2 mmHg per second). Listen with the stethoscope for the initial detection of the systolic pressure (make a mental note of this number). Continue releasing the cuff and listen closely for the disappearance of the sounds (this is diastolic). If systolic is greater than 160 mmHg and or diastolic is greater than 90 mmHg, instruct the subject to sit quietly for an additional 5 minutes and then repeat the procedure. If the recordings are still above these thresholds, instruct the subject to see a medical professional. At this time the subject may no longer participate until being seen by a medical professional and being cleared to exercise. Blood pressure measurements may indicate a greater risk of hypertension and or other potentially related health risk elements (CSEP, 2013). Both systolic and diastolic blood pressure will be recorded to the nearest whole numbers

Pretest Screening

Informed Consent letters and Get Active Questionnaires were signed and completed prior to the first data collection period (see Appendix B and C). Participants will be informed of benefits of checking heart rate and blood pressure before measurements along with describing the purpose of recording height, weight and wingspan for American Ninja Warrior comparisons. Explanations for each chosen fitness test will be described to the participants for comparisons to the ANW course.

Participant Information

The subjects participating in this experiment will be 19-24 years old. Three male and three female varsity basketball athletes are being tested so exceptional levels of fitness are expected. The participants' results will be recorded in the data collection package (see Appendix E).

Selected Fitness Tests

Queen's step test.

Why we chose it: we will be conducting the Queen's step test for all of the participants because it is a valid and reliable, indirect submaximal measure of aerobic fitness – something that is key to success as an ANW. A study performed by Abdossaleh & Ahmadi (2013) demonstrated that the Queen's step test had significant correlation ($r=0.68$, $p<0.001$) to the 20-meter shuttle run in assessing and predicting maximum oxygen uptake. The Queen's step test was chosen because of its mass testability, the minimal equipment and costs involved, and how little time was required. This test was also chosen because it was easily administered to different participants, many of whom had different availabilities. **Fitness construct measured:** this test is primarily collecting data for individual aerobic fitness. **Equipment needed:** the equipment

required to run this test will be steps for every participant taking the test, a stopwatch, the Queen's step test cadence tape, a 16 and a quarter inch step for each participant, and optional heart rate monitor and accompanying watches. **Protocol:** if using a HR monitor and watch, ensure they are synchronized and working properly. Participants will then step up and down on the step at a rate of 22 steps per minute for females and at 24 steps per minute for males. The participants are to step using a four-step cadence, 'up-up-down-down' for three continuous minutes. Upon completion of the test, heart rate is either measured by the heart rate monitor or palpated for 10 seconds and multiplied by 6 to give a beats per minute value. This value is then entered into a specific equation used to predict VO_{2max} . The equation will yield a predicted VO_{2max} to the nearest 0.1 mL/min/kg.

Dynamometer grip strength test.

Why we chose it: the grip strength test will be included in this test battery because throughout the ANW courses, there is reliance on suspension of full body weight while performing other difficult tasks--so this data collection will be telling of how these athletes would fair during an ANW competition. This test is commonly used to reliably and validly predict grip strength, as shown by a study conducted by Chkeir, Jaber, Hewson, & Duchene (2012) which yielded an intraclass correlation of 0.953 and a linear regression r-value of 0.88 when compared to the gold standard in grip force measurement, the Jamar dynamometer. **Fitness construct measured:** the data collected from this test will provide the grip strength of the subjects. **Equipment needed:** the equipment required to conduct this evaluation is a hand-held dynamometer, with a gauge display that shows grip strength. **Test location:** this test will be held in the CARSA performance gym on the UVIC campus. **Protocol:** during the dynamometer grip strength test, the participants will be instructed to hold the instrument between their fingers and

palm, so that the middle of the fingers fit tightly under the handle. The instrument should be held out to the side of the body while the subject squeezes the handle with maximal effort--ensuring the instrument and arm do not contact the body. The participants will be instructed to exhale during the test. Each hand will be alternately measured twice, and the scores will be rounded to the nearest kg. The combined scores of both right and left hands will be used to measure grip strength as a comparison with normative data (CSEP, 2013).

Vertical jump test.

Why we chose it: the vertical jump protocol will be part of this experiment because many of the ANW obstacles require explosive upward movements, primarily utilizing the muscles of the legs and glutes. Therefore, the vertical jump evaluation will provide further evidence to either support success or suggest a poor outcome for the ANW course. An evaluation performed by Aragón (2000) looked at the validity and reliability of the countermovement vertical jump test which yielded an intraclass correlation of 0.994 and a simple regression r-value of 0.952 when compared to three other vertical jump test methods. We will use the countermovement jump because it was a more accurate representation of the jumping that participants will do in an ANW run compared to CSEP's vertical jump protocol. **Fitness construct measured:** the vertical jump test primarily focuses on maximal power output of the lower extremities. **Equipment needed:** to accurately measure the max vertical jump of the participants, the Vertec apparatus will be used. **Test location:** this test will be held in the CARSA performance gym on the UVIC campus. **Protocol:** the vertical jump test will begin with participants standing next to the Vertec apparatus with both feet on the ground, and a fully extended arm/hand. This stand and reach height will be recorded to the nearest 0.5 cm. Then, participants will jump as high as possible, with countermovement allowed, hitting the

measurement flaps with a maximally extended arm. Two jump heights will be recorded, allowing 10-15 seconds rest between each jump. The Sayers equation will be used to calculate peak power, to the nearest 0.5 Watts.

Sit and reach flexibility test.

Why we chose it: the ANW competition requires contestants to be strong, agile, quick, and flexible. Participant flexibility is important in order to allow working muscles to optimally perform a variety of movements--even in outstretched positions. A study performed by Mier (2011) showed that the sit and reach flexibility test yielded an ICC of 0.98 to prove the test's reliability. The study also demonstrated moderate criterion validity by yielding a validity coefficient of 0.81 for women and 0.66 for men when compared to the passive straight-leg raise test. **Fitness construct measured:** the sit-and-reach test will measure participant lower body flexibility. **Equipment needed:** this evaluation will be carried out using the flexometer device.

Test location: this test will be held in the CARSA performance gym on the UVIC campus.

Protocol: the participants will complete a short warm-up prior to the test, including 20 seconds of lower extremity stretching performed twice per side. The warm-up will ensure subject safety and limit injury possibility. Then, participants will sit on the ground with outstretched legs, without shoes, and feet positioned six inches apart against the flexometer. With one hand placed on top of the other, subjects will reach forward with fully extended arms, while sliding the marker as far away as possible and making sure participants' knees do not bend throughout. The score will be rounded to the nearest 0.5 cm. The fully extended position will be recorded if they can hold it for two seconds. Two separate evaluations will be recorded (CSEP, 2013).

Shoulder flexibility test.

Why we chose it: the ANW competition requires contestants to perform many callisthenic, upper-body movements that require participants to utilize their entire shoulder range of motion. A study performed by Werner et al. (2014) validated the use of smartphone clinometers to measure shoulder range of motion by yielding an intraclass correlation of 0.98 when compared to a goniometer. **Fitness construct measured:** the shoulder flexibility test will measure participant flexibility and range of motion of the shoulder joint. **Equipment needed:** the equipment required to run this test will be the iPhone application Goniometer Pro (version 2.7) and a right-angle wall. **Protocol:** the participant will stand against the right-angle wall, with their shoulder blades and heels touching the wall. They will flex and extend their shoulder against the other side of the right-angle wall through their active range of motion and mark each endpoint with a piece of tape. Goniometer Pro will then be used to measure the angle of range of motion between the two pieces of tape to assess flexibility. For the purposes of scoring, the mean of right and left shoulder ROM will be used. In their study, Gannon & Bird (1999) showed that the average range of motion in the shoulder for flexion and extension in gymnasts was 244 degrees, and the same test in controlled subjects was 232 degrees. With this data in mind, we decided to have three classification categories for this test - “excellent” if the participant has shoulder ROM comparable to that of a gymnast’s or more, “good” if the participant has ROM between that of an average control and a gymnast, and “poor” if their shoulder ROM is below that of an average control’s. Shoulder ROM will be measured to the nearest 0.5 cm.

Maximum repetition pull-up.

. **Why we chose it:** pull ups will be a central component in this test battery because most of the obstacles in ANW involve suspending one’s body weight, monkey-bar type swinging

tests, and pulling one's self up and onto platforms of varying height. ***Fitness construct measured:*** the maximum repetition pull-up test is a measure of participant strength and muscular endurance--integral assets to a successful ANW contestant. ***Equipment needed:*** for this test, participants will use a pull-up bar. ***Test location:*** this test will be held in the CARSA performance gym on the UVIC campus. ***Protocol:*** starting from a hanging position on the pull-up bar, with hands in a pronated grip, participants will be instructed to pull themselves up so that their chin is above the bar and lower themselves back down to the initial hanging position. Subjects will be given one trial to perform as many pull-up repetitions as they can in a row without stopping at the top or bottom position. Only full repetitions will be counted.

Maximum hang time.

Why we chose it: during ANW competitions, the upper body of participants must be strong in order to complete obstacles that often require body weight suspension for long periods of time. Therefore, the maximum hang time will be a fitting test to measure participant suitability for the majority of tasks within ANW. ***Fitness construct measured:*** the maximum hang time test will provide information on participant upper body endurance and grip strength. ***Equipment needed:*** the max hang time test will be conducted using two climbing holds mounted on a wall, along with a stopwatch to monitor time. ***Test location:*** this test will be held in the CARSA performance gym on the UVIC campus. ***Protocol:*** participants will begin by stepping up to the wall and grabbing a climbing hold with each hand. They will then hang from their hands with their body suspended above the ground, and the stopwatch will be used to measure time. Time will be recorded to the nearest 100th of a second.

70 m obstacle course.

Why we chose it: in order to best simulate ANW, we constructed a 70 m obstacle course that is designed to test participants agility and speed. The components within the course are designed to be similar to what ANW participants would experience. This particular test will be a large contributing factor in assessing participant success and ability to be a ANW. **Fitness construct measured:** the obstacle course will test participant agility and speed. **Equipment needed:** the obstacle course will require six foam rings, a plyometric box 24-30-inch, tape, pylons/cones and a stopwatch. **Test location:** this test will be held in the CARSA performance gym on the Uvic campus. **Protocol:** participants will begin at the starting line in front of the 6 foam rings. They will begin by jumping through the five rings with one foot in each ring alternating sides. Participants will then approach the two-feet high plyometric box and perform 10 box jumps. To perform these correctly participants must have both feet on the ground previous to take-off, and when landing on the box. Stepping off the box and onto the ground is by participants comfort. Pylons will then be aligned where the participant must run around them completely. After the last pylon, the participant must run two cones indicating a turnaround line, where the participant must turn around and sprint back 30 metres (see Appendix C). Exact dimensions of obstacles are also found in Appendix C. Time will be recorded to the nearest 100th of a second.

Only the participants' best time will be recorded, but multiple trials will be completed for some of the tests. The obstacle course, sit-and-reach flexibility test, and grip test will be run twice by each participant. There will be three recordings of their vertical jump test. It will be the participant's choice if they want to complete two attempts at their max pull-ups or max hang time for upper body strength and upper body endurance.

Scoring

Once each participant (assigned a number from P1-P6) has completed the tests, the results will be separated into five categories (with a score from one to five) for each test ranging from “poor” to “excellent” (see tables in Results for test-specific information). These scores will then be multiplied by a factor of either one, two, or three depending on each construct’s estimated importance in the ANW competition. The obstacle course, maximum hang time, and grip test scores will each be multiplied by three. The vertical jump, maximum repetition pull-up, and shoulder flexibility scores will each be multiplied by two. The sit and reach and Queen’s step test will both retain their original weighting. Finally, the scores from all of the tests will be added together to determine each participant’s total score (out of a possible 81). Participants with a score of 68 or higher (based on obtaining four or more for each test) will be considered competitive in the ANW city qualifiers (the first of three rounds).

It is worth noting that, where applicable, male CSEP health benefit rating standards will be used when calculating the score ranges for each of the five categories. This was decided because the ANW obstacle course remains the same for both men and women. No women and only two men have ever completed all three rounds of the course. Due to the greater degree of success by males, it made sense to use male standards as the parameters for the tested constructs.

Results

The scores for each participant are shown in the table below. This provides a helpful summary showing how each participant fared overall as well as in each individual category.

Table 2.

Weighted data scores for all 8 fitness tests. OC = obstacle course, MHT = max hang time, GT = grip test, VJ = vertical jump, MRP = max rep pull-ups, SF = shoulder flexibility, SR = sit and reach, QST = Queen's step test

Participant	OC	MHT	GT	VJ	MRP	SF	SR	QST	Total
	(x3)	(x3)	(x3)	(x2)	(x2)	(x2)	(x1)	(x1)	
P1	9	9	15	10	8	4	3	5	63
P2	9	6	15	10	8	6	5	4	59
P3	9	9	15	8	6	2	1	5	55
P4	3	9	3	6	2	2	1	1	27
P5	6	9	3	8	2	6	2	1	37
P6	9	9	3	6	2	4	1	1	35

In the 70-metre obstacle course, our participant scores ranged from 30.55 - 41.08 seconds with a mean score of 35.09 seconds, as seen in Figure 1. There was no discernible difference between male and female participants. Our obstacle course had a Pearson correlation score of 0.92.

Table 3.

Participant obstacle course scoring based on standard deviations of the mean performance.

Obstacle course score	Time (seconds)	Classification
1	>40	Poor
2	35-39.9	Fair
3	30-34.9	Good
4	25-29.9	Very good
5	<25	Excellent

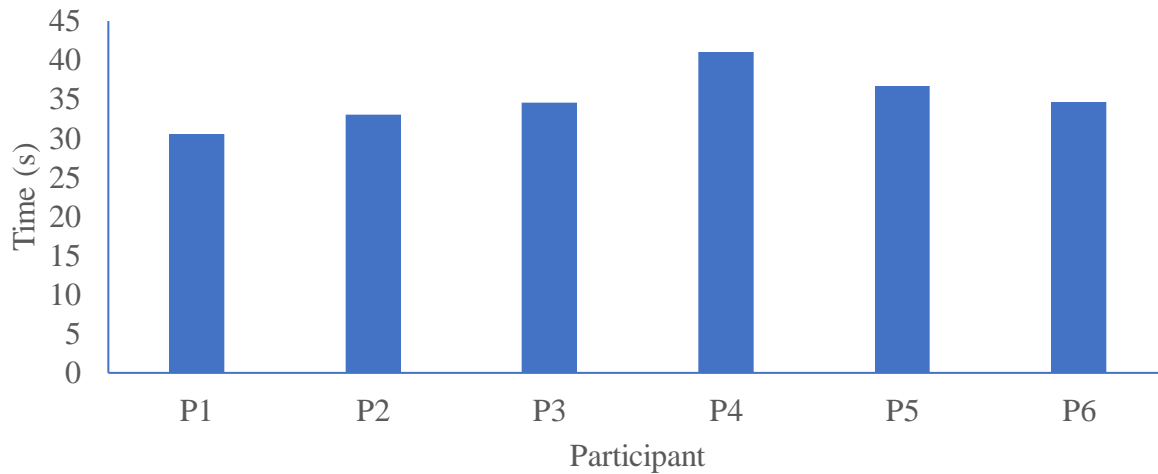


Figure 1. Distribution of participant's obstacle course times.

In the maximum repetition pull-up test, our participant scores ranged from 0 - 13 successfully completed pull-ups with a mean of 5.3 repetitions, as seen in Figure 2. There was a noticeable split between the results of males and females, with all three female participants falling into the “poor” category which corresponded to a score of 0-4 repetitions, and no male participants. No participant scored in the “excellent” category.

Table 4.

Participant pull-up scoring based on standard deviations of the mean performance.

Pull-ups score	Repetitions	Classification
1	<4	Poor
2	5-8	Fair
3	9-12	Good
4	13-16	Very good
5	17-20	Excellent

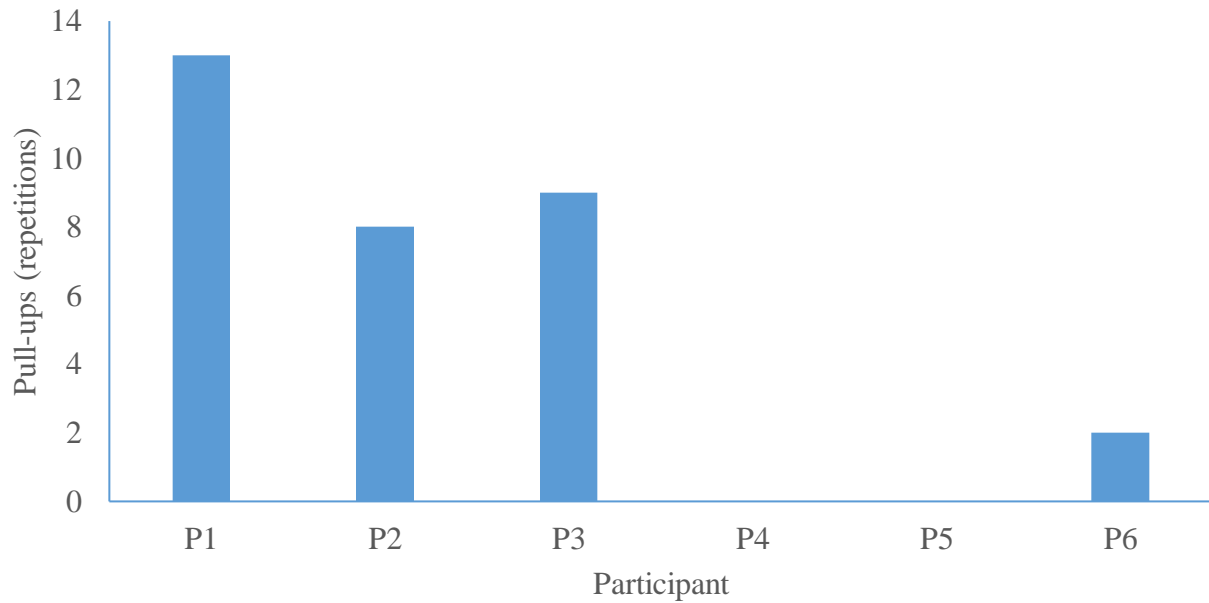


Figure 2. Distribution of participant pull-up scores.

In the maximum hang time test, our participant scores ranged from 48.82 - 74.28 seconds with a mean of 59.66 seconds, as seen in Figure 3. All but one of the participants scored in the “good” category which corresponded to a score of 56-83 seconds. There was no discernible difference between males and females.

Table 5.

Participant hang time scoring based on standard deviations of the mean performance.

Hang time	Time (seconds)	Classification
1	<27	Poor
2	28-55	Fair
3	56-83	Good
4	84-111	Very good
5	>112	Excellent

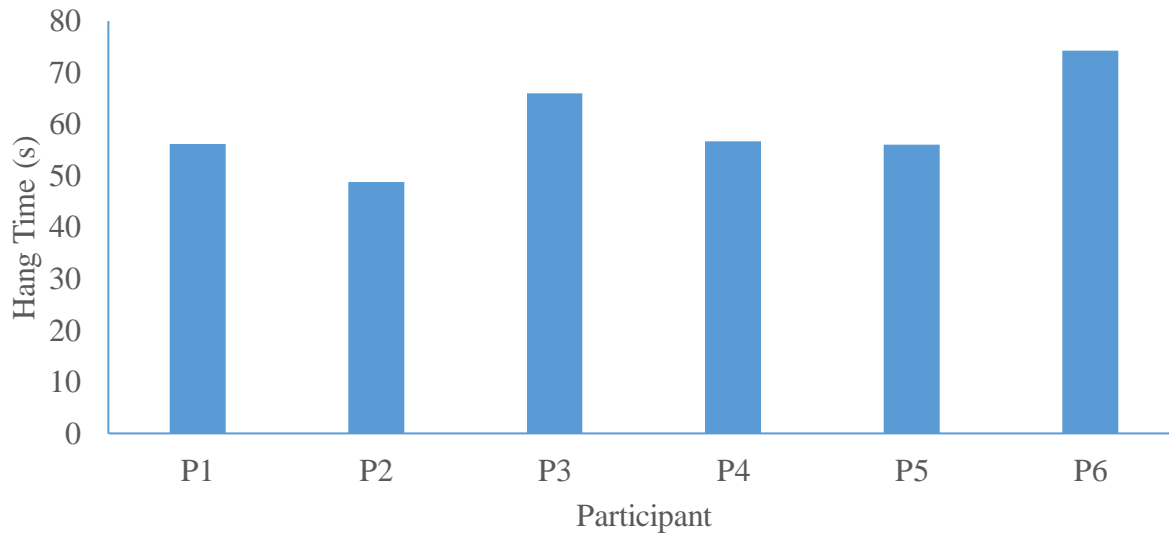


Figure 3. Distribution of participant hang time scores.

In the grip test, our participant scores ranged from 59 - 143.5 kilograms with a mean of 97.4 kilograms, as seen in Figure 4. There was a drastic difference between the male and female participant scores, with all three females scoring in the “poor” category while all three males scored in the “excellent” category.

Table 6.

Participant grip strength scoring based on standard deviations from the mean performance.

Grip strength score	Force (kg)	Classification
1	<83	Poor
2	84-94	Fair
3	95-103	Good
4	104-114	Very good
5	>115	Excellent

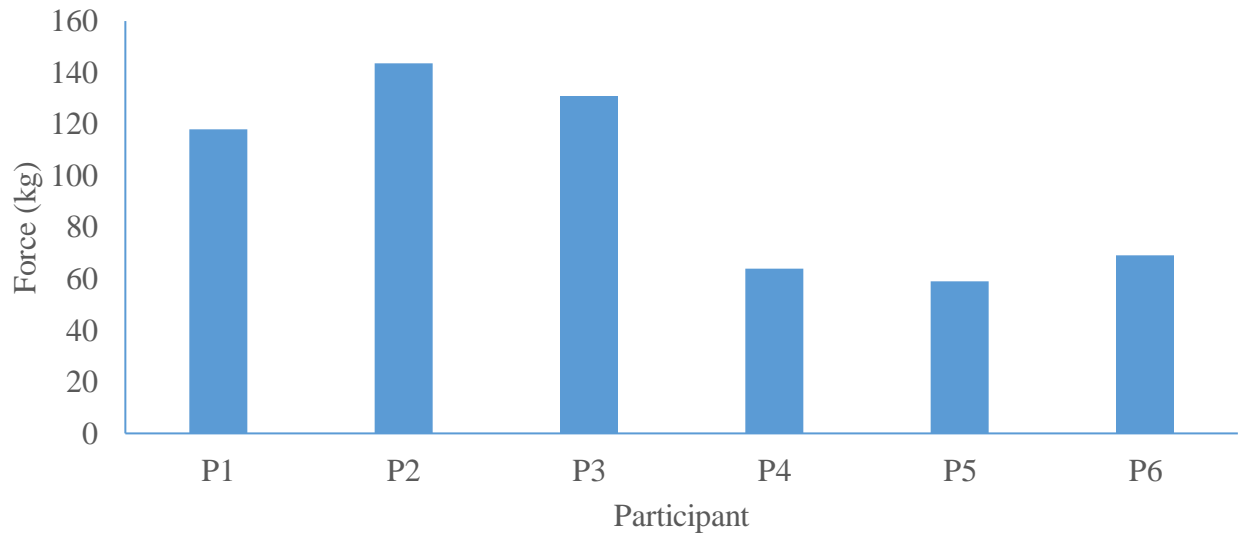


Figure 4. Distribution of participant grip strength scores.

In the vertical jump test, our participant scores ranged from 41.5 to 76.0 centimetres with a mean of 60.08 centimetres, as seen in Figure 5. There was no observable difference between male and female participants.

Table 7.

Participant vertical jump scoring based on standard deviation from the mean performance.

Vertical jump score	Height (centimetres)	Classification
1	<30	Poor
2	31-40	Fair
3	41-55	Good
4	56-70	Very good
5	>70	Excellent

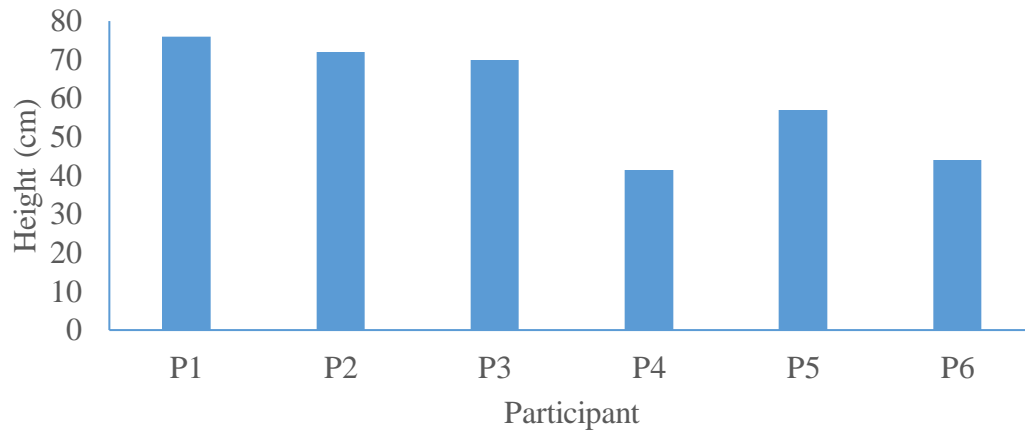


Figure 5. Distribution of vertical jump scores.

In the sit-and-reach flexibility test, our participant scores ranged from 11.0 - 43.0 centimetres with a mean score of 25.08 centimetres, as seen in Figure 6. There was no noticeable difference between male and female participants.

Table 8.

Participant sit and reach scoring based on standard deviations from the mean performance.

Sit-and-reach score	Reach (centimetres)	Classification
1	<24	Poor
2	25-29	Fair
3	30-33	Good
4	34-39	Very good
5	>43	Excellent

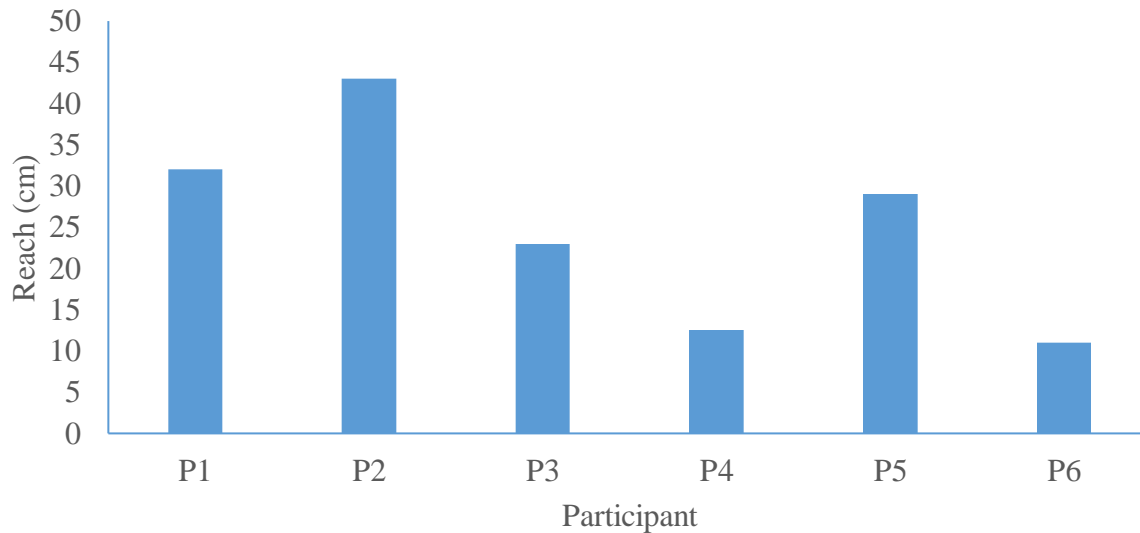


Figure 6. Distribution of participant sit and reach scores.

In the shoulder flexibility test, our participant scores ranged from 217 - 249.5 degrees in the right shoulder and 218 - 252 degrees in the left shoulder, as seen in Figure 7.. The mean score was 237.38 degrees, and there was no observable difference between male and female participants.

Table 9.

Participant shoulder range of motion based on standard deviations from the mean performance.

Shoulder ROM score	Range of motion (degrees)	Classification
1	<231.9	Poor
2	232-243.9	Good
3	>244	Excellent

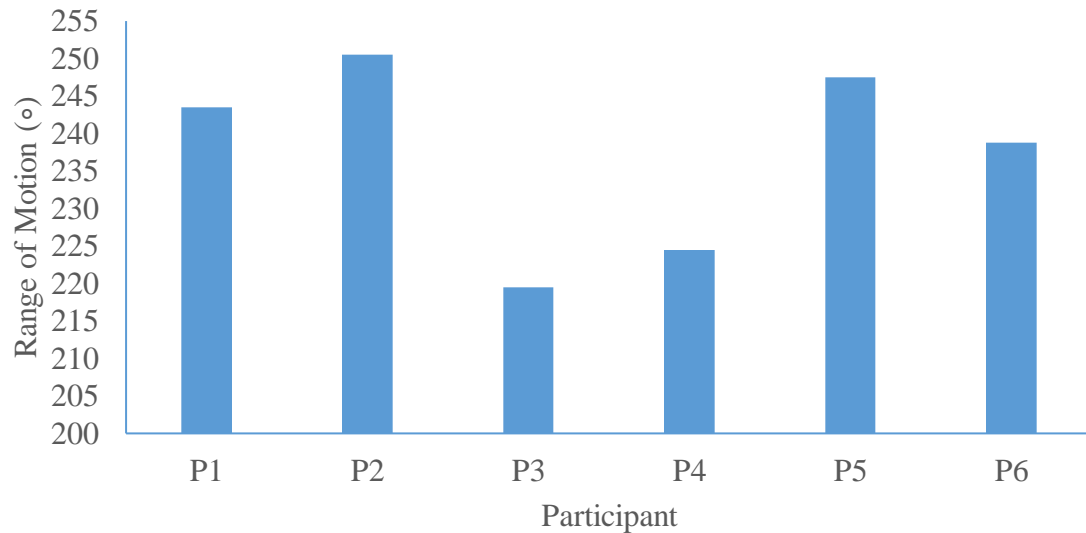


Figure 7. Distribution of participant shoulder range of motion scores.

In the Queen's step test our participant predicted $\text{VO}_{2\text{max}}$ scores ranged from 29.2 - 60.9 ml/min/kg with a mean of 45.4 ml/min/kg, as seen in Figure 8. As in other tests, the male participants scored significantly better than the female participants with all female participants falling in the "poor" category of 41.6 ml/min/kg or below.

Table 10.

Participant Queen's step test scores based on standard deviations from the mean performance.

Queen's Step Test score	Predicted $\text{VO}_{2\text{max}}$ (mL/min/kg)	Classification
1	<41.6	Poor
2	41.7-47.1	Fair
3	47.2-50.5	Good
4	50.6-55.5	Very good
5	>55.6	Excellent

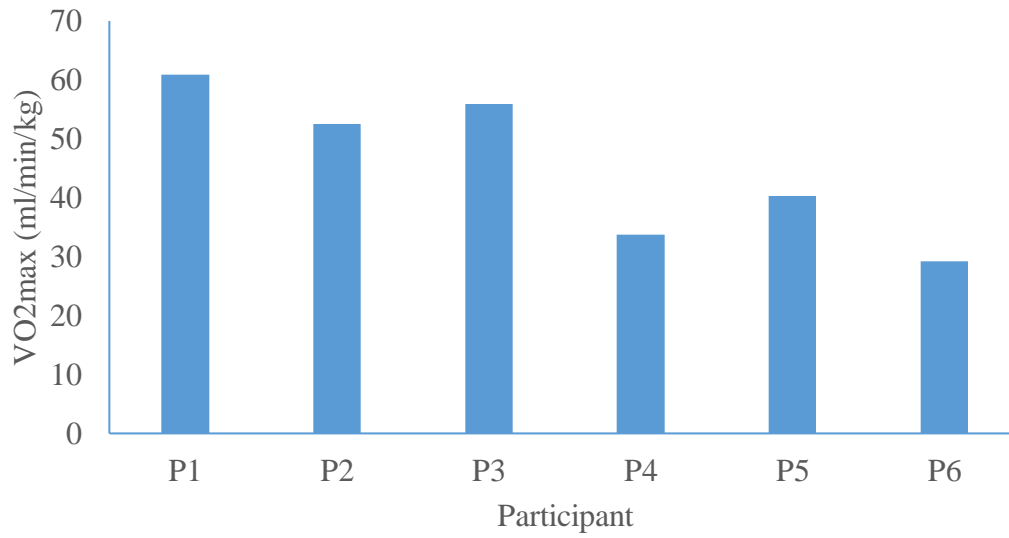


Figure 8. Distribution of Queen's step test scores.

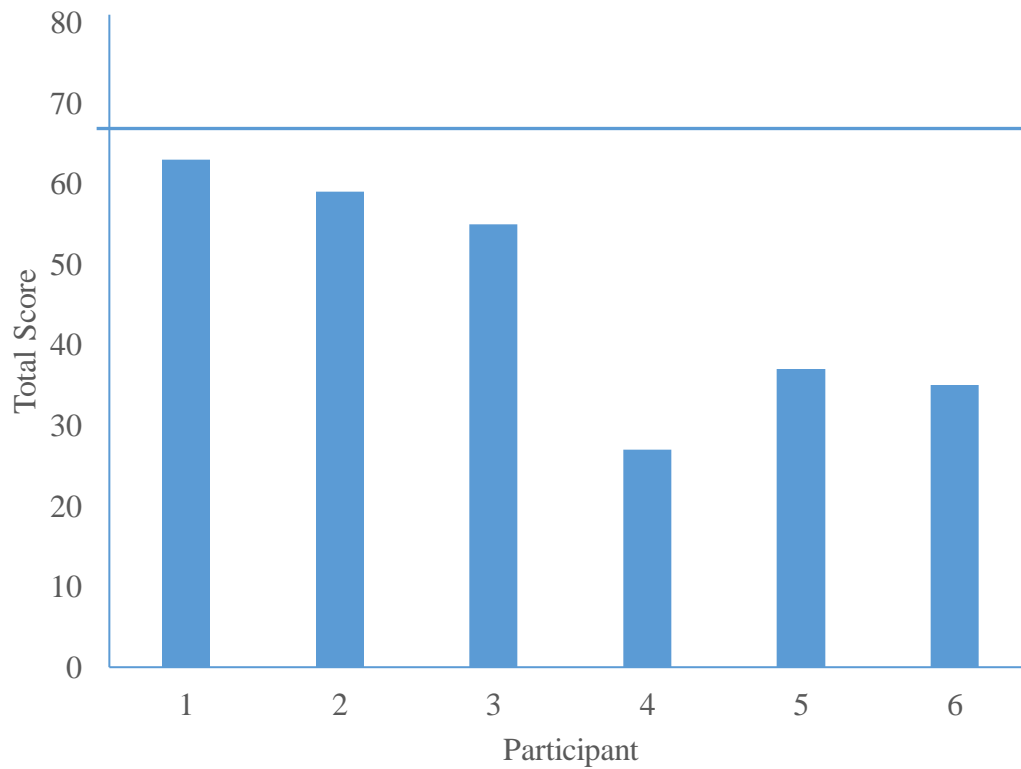


Figure 9. Overall distribution of participant's final weighted scores compared to our cut-off threshold.

Discussion

In the current study, we attempted to answer how the skill-set of a varsity basketball athlete would translate to performance in an ANW contest. From our results, it is shown that none of the participants would be recommended to compete for the city qualifier round of ANW. The top score recorded was 63 out of 81 by one of the male participants, which is shown in Figure 9. Based on the points system, even the top scoring participant would not have been a successful competitor in ANW. Our research objective was met as we successfully tested six varsity athletes. However, our results show that a varsity basketball skill-set does not necessarily translate to success as an ANW competitor.

Although this test battery was carefully thought through and designed prior to its administration, there were a few limitations that we encountered which could have potentially influenced the validity and reliability of our project. Our busy schedules combined with the travelling aspect and rigorous schedule of the basketball teams made it difficult to find time to test the participants and have all of our group members present. However, most of the selected tests presented few difficulties with administration. Our selected participants are athletes, so they were comfortable performing most tasks and were very accommodating to work with.

Obstacle course

The obstacle course was the most important test within our battery and therefore was ranked among the highest out of all selected tests for scoring purposes. The reason for this is that it is the most similar to an ANW competition course. The test measures a combination of subject agility, speed and power. In regard to practicality, the obstacle course was relatively simple to set up and was performed in a controlled environment. However, it required a large amount of space, a variety of equipment, supervisors and invigilators (timing the participants, informing

them with any instructions, etc.), and time to set up and organize. Additionally, because we developed this test ourselves, it lacks normative data to which we could compare our results to. Another reason for the inclusion of this obstacle course within our test battery was that it had a high level of discrimination. A quicker time and higher score directly related to a more agile and quick athlete. The sensitivity between trained and untrained people would have been more apparent if we had a control group which we could compare the basketball athlete scores to. We believe the obstacle course is an appropriate test to be used to make decisions about speed, agility and power in varsity basketball players in order to test for potential success as an ANW.

Grip strength

Upper body strength is a key component to success as an ANW, and the grip strength test is a direct measure of upper body strength. It is simple to administer, quick to complete, and easily portable. We tested each subject in a controlled laboratory environment. This test requires one administrator per participant. Further, grip strength is a widely used test protocol with ample normative data to which we can compare our results. There is clear documentation outlining the proper use and instruction for the grip strength dynamometer. In regards to practicality, the physical dynamometer can be expensive, ranging from \$30.00 CAD on Amazon to approximately \$500.00 CAD and upwards. Price usually corresponds to quality and range of measurement. Due to limited access to hand grip dynamometers, mass testability was low for this test. We believe the grip strength test through use of the hand dynamometer is an appropriate evaluation tool to be used to make decisions about upper body strength in varsity basketball players in order to measure potential success as an ANW.

Hang time

Hang time is reflective of upper body endurance which is required in ANW participants. In regard to practicality, access to rock climbing equipment or a pull up bar to properly assess hang time proved to be challenging. We were fortunate to have free access to CARSA, the UVic gym, where there is official rock-climbing equipment and specifically an apparatus where hang time can be tested. This test requires one administrator per participant. Further, timing of each test per participant was variable, therefore we had to allow for extra time. Each participant had to complete the test one at a time due to limited equipment and space; therefore, mass testability was low. Even though there was no official documentation, the test was simple and straightforward to administer and complete. The test was performed in an uncontrolled noisy gym environment which added distractions and variation in conditions. Due to the variable conditions such as an open gym environment and random words and noises of encouragement, our participants results may have been influenced. However, the loud environment may have been a strong simulation of an ANW run, where there are lights, cameras, and a live audience present during a participant's run. Despite a potentially distracting testing environment, we believe the hang time test is an appropriate assessment which can be used to make decisions about isometric upper body muscular endurance and grip strength in varsity basketball players in order to measure potential success as an ANW.

Pull ups

Pull ups are a good measurement of upper body strength and muscular endurance. Simple to administer and easy to comprehend, pull ups are a common measurement utilized to assess many populations. Pull up equipment (pull up bar) is common in most gyms and recreation facilities and it is relatively easy to purchase for installation if gym access is limited. For our

experiment, all pull up tests were performed in CARSA in the UVic fitness and weight center. This test requires one administrator per participant during performance. This test had high mass testability due to the number of accessible pull up bars in the CARSA facility. This test was not performed in a controlled environment. Varying noise levels may have influenced participants motivation and results. Two of our female participants were unable to perform pull ups; therefore, they scored a zero, which impacted their overall score. In reflection, we could have chosen a different upper body test that all of our participants could complete successfully to provide discrimination between all participants. Overall, we believe the pull up test is an appropriate measure to be used to make decisions about upper body strength and muscular endurance in varsity basketball players in order to measure potential success as an AWN.

Vertical jump

Vertical jump is a direct test of lower body power which is crucial for navigating the highly variable and physically demanding ANW course. This assessment was conducted in a large open space gym with limited distractions using a Vertec apparatus. This test requires at least one administrator per participant, however, two are preferred. Even though we only had access to one Vertec apparatus, this test had high mass testability and was simple to set up, administer, and complete. The participants were comfortable performing these jump tests because of the frequent jumps required in basketball practices and games. Documentation for this test is clear and easily accessible. We believe the vertical jump test is an important evaluation mechanism to be used to make decisions about lower body strength and power in varsity basketball players in order to measure for potential success as an ANW.

Shoulder ROM

Evaluation of shoulder range of motion provides us with an assessment of shoulder flexibility which is necessary for navigating the ANW course. In regard to practicality, equipment was easy to access via mobile phone application (iPhone Goniometer Pro Version 2.7) as well as access to a right-angled wall. This test was simple to set up, administer, and perform. This test can be mass testable if one has access to enough equipment. This test requires one administrator per participant. Documentation was provided by the iPhone application and otherwise general documentation is easily accessed via a simple Google search. We believe the shoulder range of motion test is an appropriate assessment to be used to make decisions about appropriate shoulder range of motion as well as injury prevention in varsity basketball players in order to measure potential success as an ANW.

Queen's Step Test

The Queen's step test is reflective of general aerobic fitness, which is required for ANW success. This test is mass testable and is consistently 3 minutes long. Additionally, normative data is available for comparison and it is easy to access the required equipment. This test was simple to administer, set up and complete. Participants felt confident to take their own carotid pulse post-exercise/post-test, which in hindsight, may have led to validity/reliability inconsistencies (compared to administrators measuring it or using heart rate monitors). Further, we prioritized the mass testability and timeliness that this protocol offers over the direct/gold standard measure of a metabolic cart VO₂max test, which would have provided us with more precise and accurate results. Participant availability and motivation were also factors that led to us choosing the Queen's Step test over a test such as the 20-meter shuttle run. We believe the

Queen's Step test is an appropriate measure to be used to make decisions about general aerobic fitness in varsity basketball players in order to measure for potential success as an ANW.

Sit and Reach

This is an assessment of lower body flexibility which is advantageous for ANW athletes. We had access to only one sit-and-reach box, so it was not mass testable. However, we had one subject performing the warm-up protocol (modified hurdler stretches) while another took the test, which increased efficiency. This test required at least one administrator per participant. This test is well documented, has been widely used, and has normative data to which we can compare. We believe the sit and reach test is an appropriate evaluation tool to be used to make decisions about hip range of motion and general flexibility in varsity basketball players in order to measure potential success as an ANW.

Participant feedback

We collected participant feedback through a questionnaire, as we were constantly looking to improve our administrative and research skills. We must reflect on our test battery choices and use feedback to further refine our project and better inform future similar experiments. See the appendix for feedback from our six participants.

Future recommendations

For a future re-creation of this test battery by another research group, or a similar re-run of the project, there are multiple recommendations that arose from what we have learnt through this process. These recommendations include incorporating a balance test, for example the one leg stance, because the ANW athletes must be able to navigate difficult courses all while remaining centered/balanced with a strong core. Another suggestion would be to source additional dynamometers to increase mass testability and expedite the grip strength testing.

Further, an alternative test for pull ups might be used so that all subjects are able to participate, because two of our female subjects were not able to complete them. However, pull ups are essential for the success of an ANW, so keeping them in the test battery is important. Another future recommendation would be to incorporate upper body exercise(s) into the obstacle course to make it as specific to ANW as possible. Additionally, we would incorporate a broad jump test as it most closely simulates a key movement of all ANW courses. A successful ANW must be able to not only jump high but they must also be able to jump far from obstacle to obstacle. Lastly, a core test would be beneficial to incorporate in a future test battery as core helps to stabilize and coordinate all human movements as well as prevent injury.

Conclusion

In the present study, we examined how three male and three female varsity basketball athletes would perform in a simulated American Ninja Warrior course. We used a test battery that targeted the assessment of some of the essential skills that a successful ANW competitor must have (speed, agility, flexibility, upper and lower body strength, etc.). Through the completion of the test battery, we have concluded that the skill set of a varsity basketball athlete (male or female) does not necessarily translate to success as an ANW. Future revisions to the experiment including a core test, balance test, broad jump, etc., would result in a more well-rounded and accurate evaluation of these athletes.

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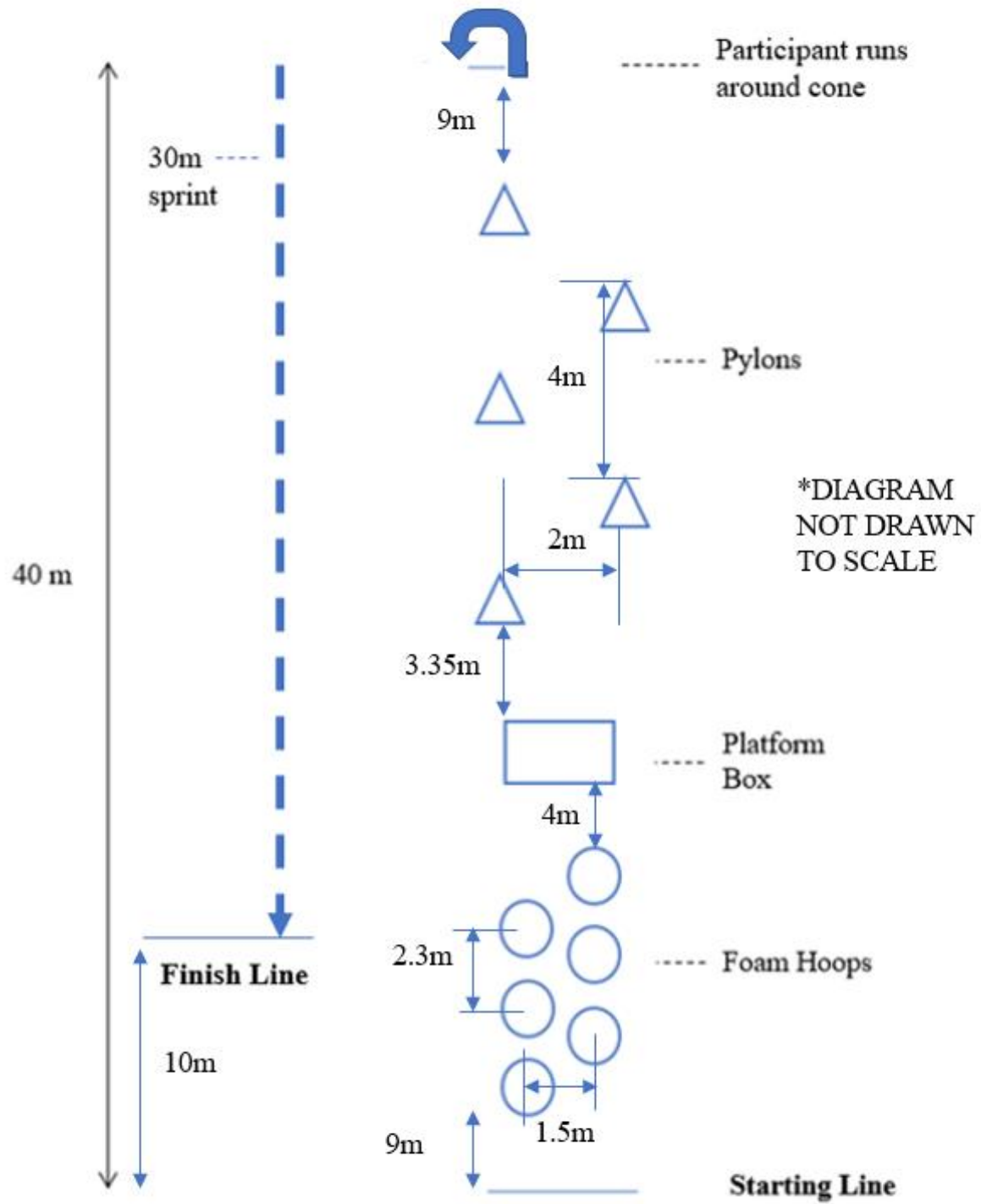
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Appendix A
Obstacle course basic diagram



Appendix B CSEP Get Active Questionnaires



Get Active Questionnaire

CANADIAN SOCIETY FOR EXERCISE PHYSIOLOGY –
PHYSICAL ACTIVITY TRAINING FOR HEALTH (CSEP-PATH®)

Physical activity improves your physical and mental health. Even small amounts of physical activity are good, and more is better.

For almost everyone, the benefits of physical activity far outweigh any risks. For some individuals, specific advice from a Qualified Exercise Professional (QEP – has post-secondary education in exercise sciences and an advanced certification in the area – see csep.ca/certifications) or health care provider is advisable. This questionnaire is intended for all ages – to help move you along the path to becoming more physically active.

- ☒ I am completing this questionnaire for myself.
- ☐ I am completing this questionnaire for my child/dependent as parent/guardian.

YES	NO	PREPARE TO BECOME MORE ACTIVE
		The following questions will help to ensure that you have a safe physical activity experience. Please answer YES or NO to each question <u>before</u> you become more physically active. If you are unsure about any question, answer YES.
		1 Have you experienced <u>ANY</u> of the following (A to F) within the past six months?
		A A diagnosis of/treatment for heart disease or stroke, or pain/discomfort/pressure in your chest during activities of daily living or during physical activity?
		B A diagnosis of/treatment for high blood pressure (BP), or a resting BP of 160/90 mmHg or higher?
		C Dizziness or lightheadedness during physical activity?
		D Shortness of breath at rest?
		E Loss of consciousness/fainting for any reason?
		F Concussion?
		2 Do you currently have pain or swelling in any part of your body (such as from an injury, acute flare-up of arthritis, or back pain) that affects your ability to be physically active?
		3 Has a health care provider told you that you should avoid or modify certain types of physical activity?
		4 Do you have any other medical or physical condition (such as diabetes, cancer, osteoporosis, asthma, spinal cord injury) that may affect your ability to be physically active?
	 > NO to all questions: go to Page 2 – ASSESS YOUR CURRENT PHYSICAL ACTIVITY >
		YES to any question: go to Reference Document – ADVICE ON WHAT TO DO IF YOU HAVE A YES RESPONSE . . . >>

Get Active Questionnaire

ASSESS YOUR CURRENT PHYSICAL ACTIVITY

Answer the following questions to assess how active you are now.

- 1 During a typical week, on how many days do you do moderate- to vigorous-intensity aerobic physical activity (such as brisk walking, cycling or jogging)? DAYS/
WEEK
 - 2 On days that you do at least moderate-intensity aerobic physical activity (e.g., brisk walking), for how many minutes do you do this activity? MINUTES/
DAY
- For adults, please multiply your average number of days/week by the average number of minutes/day: MINUTES/
WEEK

Canadian Physical Activity Guidelines recommend that adults accumulate at least 150 minutes of moderate- to vigorous-intensity physical activity per week. For children and youth, at least 60 minutes daily is recommended. Strengthening muscles and bones at least two times per week for adults, and three times per week for children and youth, is also recommended (see csep.ca/guidelines).



GENERAL ADVICE FOR BECOMING MORE ACTIVE

Increase your physical activity gradually so that you have a positive experience. Build physical activities that you enjoy into your day (e.g., take a walk with a friend, ride your bike to school or work) and reduce your sedentary behaviour (e.g., prolonged sitting).

If you want to do **vigorous-intensity physical activity** (i.e., physical activity at an intensity that makes it hard to carry on a conversation), and you do not meet minimum physical activity recommendations noted above, consult a Qualified Exercise Professional (QEP) beforehand. This can help ensure that your physical activity is safe and suitable for your circumstances.

Physical activity is also an important part of a healthy pregnancy.

Delay becoming more active if you are not feeling well because of a temporary illness.



DECLARATION

To the best of my knowledge, all of the information I have supplied on this questionnaire is correct.
If my health changes, I will complete this questionnaire again.

I answered **NO** to all questions on Page 1

I answered **YES** to any question on Page 1

Sign and date the Declaration below

Check the box below that applies to you:

- ☐ I have consulted a health care provider or Qualified Exercise Professional (QEP) who has recommended that I become more physically active.
- ☐ I am comfortable with becoming more physically active on my own without consulting a health care provider or QEP.

Ashlyn Day

Name (+ Name of Parent/Guardian if applicable) [Please print]

Ashlyn Day

Signature (or Signature of Parent/Guardian if applicable)

March 12, 1999

Date of Birth

Feb 10, 2019

Date

Email (optional)

Telephone (optional)

With planning and support you can enjoy the benefits of becoming more physically active. A QEP can help.

- ☐ Check this box if you would like to consult a QEP about becoming more physically active.
(This completed questionnaire will help the QEP get to know you and understand your needs.)

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DECLARATION

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Sign and date the Declaration below



I answered **YES** to any question on Page 1

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Eric Hegadoren

Name (+ Name of Parent/Guardian if applicable) [Please print]

Eric Hegadoren

Signature (or Signature of Parent/Guardian if applicable)

02/23/95

Date of Birth

02/10/19

Date

Email (optional)

Telephone (optional)

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Hannah Walline

Name (+ Name of Parent/Guardian if applicable) (Please print)

Hannah Walline

Signature (or Signature of Parent/Guardian if applicable)

July 9, 1999

Date of Birth

Feb 10, 2019

Date

Email (optional)

Telephone (optional)

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Justin McChesney

Name (+ Name of Parent/Guardian if applicable) [Please print]

Justin McChesney

Signature (or Signature of Parent/Guardian if applicable)

02/18/98

Date of Birth

02/08/19

Date

Email (optional)

Telephone (optional)

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☐

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(This completed questionnaire will help the QEP get to know you and understand your needs.)

Use this reference document if you answered **YES** to any question and you have not consulted a health care provider or Qualified Exercise Professional (QEP) about becoming more physically active.

1 Have you experienced ANY of the following (A to F) within the past six months?

A A diagnosis of/treatment for heart disease or stroke, or pain/discomfort/pressure in your chest during activities of daily living or during physical activity?

☐ **YES**

Physical activity is likely to be beneficial. If you have been treated for heart disease but have not completed a cardiac rehabilitation program within the past 6 months, consult a doctor – a supervised cardiac rehabilitation program is strongly recommended. If you are resuming physical activity after more than 6 months of inactivity, begin slowly with light- to moderate-intensity physical activity. If you have pain/discomfort/pressure in your chest and it is new for you, talk to a doctor. Describe the symptom and what activities bring it on.

B A diagnosis of/treatment for high blood pressure (BP), or a resting BP of 160/90 mmHg or higher?

☐ **YES**

Physical activity is likely to be beneficial if you have been diagnosed and treated for high blood pressure (BP). If you are unsure of your resting BP, consult a health care provider or a Qualified Exercise Professional (QEP) to have it measured. If you are taking BP medication and your BP is under good control, regular physical activity is recommended as it may help to lower your BP. Your doctor should be aware of your physical activity level so your medication needs can be monitored. If your BP is 160/90 or higher, you should receive medical clearance and consult a QEP about safe and appropriate physical activity.

C Dizziness or lightheadedness during physical activity

☐ **YES**

There are several possible reasons for feeling this way and many are not worrisome. Before becoming more active, consult a health care provider to identify reasons and minimize risk. Until then, refrain from increasing the intensity of your physical activity.

D Shortness of breath at rest

☐ **YES**

If you have asthma and this is relieved with medication, light to moderate physical activity is safe. If your shortness of breath is not relieved with medication, consult a doctor.

E Loss of consciousness/fainting for any reason

☐ **YES**

Before becoming more active, consult a doctor to identify reasons and minimize risk. Once you are medically cleared, consult a Qualified Exercise Professional (QEP) about types of physical activity suitable for your condition.

F Concussion

☐ **YES**

A concussion is an injury to the brain that requires time to recover. Increasing physical activity while still experiencing symptoms may worsen your symptoms, lengthen your recovery, and increase your risk for another concussion. A health care provider will let you know when you can start becoming more physically active, and a Qualified Exercise Professional (QEP) can help get you started.

After reading the ADVICE for your YES response, go to Page 2 of the
Get Active Questionnaire – ASSESS YOUR CURRENT PHYSICAL ACTIVITY

Use this reference document if you answered **YES** to any question and you have not consulted a health care provider or Qualified Exercise Professional (QEP) about becoming more physically active.

2 Do you currently have pain or swelling in any part of your body (such as from an injury, acute flare-up of arthritis, or back pain) that affects your ability to be physically active?

☐ **YES**

If this swelling or pain is new, consult a health care provider. Otherwise, keep joints healthy and reduce pain by moving your joints slowly and gently through the entire pain-free range of motion. If you have hip, knee or ankle pain, choose low-impact activities such as swimming or cycling. As the pain subsides, gradually resume your normal physical activities starting at a level lower than before the flare-up. Consult a Qualified Exercise Professional (QEP) in follow-up to help you become more active and prevent or minimize future pain.

3 Has a health care provider told you that you should avoid or modify certain types of physical activity?

☒ **YES**

Listen to the advice of your health care provider. A Qualified Exercise Professional (QEP) will ask you about any considerations and provide specific advice for physical activity that is safe and that takes your lifestyle and health care provider's advice into account.

4 Do you have any other medical or physical condition (such as diabetes, cancer, osteoporosis, asthma, spinal cord injury) that may affect your ability to be physically active?

☒ **YES**

Some people may worry if they have a medical or physical condition that physical activity might be unsafe. In fact, regular physical activity can help to manage and improve many conditions. Physical activity can also reduce the risk of complications. A Qualified Exercise Professional (QEP) can help with specific advice for physical activity that is safe and that takes your medical history and lifestyle into account.

After reading the ADVICE for your YES response, go to Page 2 of the
Get Active Questionnaire – ASSESS YOUR CURRENT PHYSICAL ACTIVITY

WANT ADDITIONAL INFORMATION ON BECOMING MORE PHYSICALLY ACTIVE?

► csep.ca/certifications

CSEP Certified members can help you with your physical activity goals.

► csep.ca/guidelines

Canadian Physical Activity Guidelines for all ages.

Get Active Questionnaire

CANADIAN SOCIETY FOR EXERCISE PHYSIOLOGY –
PHYSICAL ACTIVITY TRAINING FOR HEALTH (CSEP-PATHSM)

Physical activity improves your physical and mental health. Even small amounts of physical activity are good, and more is better.

For almost everyone, the benefits of physical activity far outweigh any risks. For some individuals, specific advice from a Qualified Exercise Professional (QEP – has post-secondary education in exercise sciences and an advanced certification in the area – see csep.ca/certifications) or health care provider is advisable. This questionnaire is intended for all ages – to help move you along the path to becoming more physically active.

- ☒ I am completing this questionnaire for myself.
- ☐ I am completing this questionnaire for my child/dependent as parent/guardian.

YES	NO	PREPARE TO BECOME MORE ACTIVE
		The following questions will help to ensure that you have a safe physical activity experience. Please answer YES or NO to each question <u>before</u> you become more physically active. If you are unsure about any question, answer YES.
		1 Have you experienced ANY of the following (A to F) within the past six months?
		A A diagnosis of/treatment for heart disease or stroke, or pain/discomfort/pressure in your chest during activities of daily living or during physical activity?
		B A diagnosis of/treatment for high blood pressure (BP), or a resting BP of 160/90 mmHg or higher?
		C Dizziness or lightheadedness during physical activity?
		D Shortness of breath at rest?
		E Loss of consciousness/fainting for any reason?
		F Concussion?
		2 Do you currently have pain or swelling in any part of your body (such as from an injury, acute flare-up of arthritis, or back pain) that affects your ability to be physically active?
		3 Has a health care provider told you that you should avoid or modify certain types of physical activity?
		4 Do you have any other medical or physical condition (such as diabetes, cancer, osteoporosis, asthma, spinal cord injury) that may affect your ability to be physically active?
	 ➤ NO to all questions: go to Page 2 – ASSESS YOUR CURRENT PHYSICAL ACTIVITY ➤
		YES to any question: go to Reference Document – ADVICE ON WHAT TO DO IF YOU HAVE A YES RESPONSE ... ➤➤

ASSESS YOUR CURRENT PHYSICAL ACTIVITY

Answer the following questions to assess how active you are now.

- 1 During a typical week, on how many days do you do moderate- to vigorous-intensity aerobic physical activity (such as brisk walking, cycling or jogging)? DAYS/WEEK
 - 2 On days that you do at least moderate-intensity aerobic physical activity (e.g., brisk walking), for how many minutes do you do this activity? MINUTES/DAY
- For adults, please multiply your average number of days/week by the average number of minutes/day: MINUTES/WEEK

Canadian Physical Activity Guidelines recommend that adults accumulate at least 150 minutes of moderate- to vigorous-intensity physical activity per week. For children and youth, at least 60 minutes daily is recommended. Strengthening muscles and bones at least two times per week for adults, and three times per week for children and youth, is also recommended (see csep.ca/guidelines).



GENERAL ADVICE FOR BECOMING MORE ACTIVE

Increase your physical activity gradually so that you have a positive experience. Build physical activities that you enjoy into your day (e.g., take a walk with a friend, ride your bike to school or work) and reduce your sedentary behaviour (e.g., prolonged sitting).

If you want to do **vigorous-intensity physical activity** (i.e., physical activity at an intensity that makes it hard to carry on a conversation), and you do not meet minimum physical activity recommendations noted above, consult a Qualified Exercise Professional (QEP) beforehand. This can help ensure that your physical activity is safe and suitable for your circumstances.

Physical activity is also an important part of a healthy pregnancy.

Delay becoming more active if you are not feeling well because of a temporary illness.



DECLARATION

To the best of my knowledge, all of the information I have supplied on this questionnaire is correct.
If my health changes, I will complete this questionnaire again.

I answered **NO** to all questions on Page 1

I answered **YES** to any question on Page 1

Sign and date the Declaration below

Check the box below that applies to you:

- ☐ I have consulted a health care provider or Qualified Exercise Professional (QEP) who has recommended that I become more physically active.
- ☐ I am comfortable with becoming more physically active on my own without consulting a health care provider or QEP.

<input type="text" value="Kayla Krug"/>	<input type="text" value="Kayla Krug"/>	<input type="text" value="Jan 13, 1999"/>
Name (+ Name of Parent/Guardian if applicable) (Please print)	Signature (or Signature of Parent/Guardian if applicable)	Date of Birth
<input type="text" value="Feb 10, 2019"/>	<input type="text"/>	<input type="text"/>
Date	Email (optional)	Telephone (optional)

With planning and support you can enjoy the benefits of becoming more physically active. A QEP can help.

- ☐ Check this box if you would like to consult a QEP about becoming more physically active.
(This completed questionnaire will help the QEP get to know you and understand your needs.)

Get Active Questionnaire

CANADIAN SOCIETY FOR EXERCISE PHYSIOLOGY –
PHYSICAL ACTIVITY TRAINING FOR HEALTH (CSEP-PATH®)

Physical activity improves your physical and mental health. Even small amounts of physical activity are good, and more is better.

For almost everyone, the benefits of physical activity far outweigh any risks. For some individuals, specific advice from a Qualified Exercise Professional (QEP – has post-secondary education in exercise sciences and an advanced certification in the area – see csep.ca/certifications) or health care provider is advisable. This questionnaire is intended for all ages – to help move you along the path to becoming more physically active.

- ☒ I am completing this questionnaire for myself.
- ☐ I am completing this questionnaire for my child/dependent as parent/guardian.

YES	NO	PREPARE TO BECOME MORE ACTIVE
✓	✗	The following questions will help to ensure that you have a safe physical activity experience. Please answer YES or NO to each question <u>before</u> you become more physically active. If you are unsure about any question, answer YES .
•	•	1 Have you experienced ANY of the following (A to F) within the past six months?
•	•	A A diagnosis of/treatment for heart disease or stroke, or pain/discomfort/pressure in your chest during activities of daily living or during physical activity?
•	•	B A diagnosis of/treatment for high blood pressure (BP), or a resting BP of 160/90 mmHg or higher?
•	•	C Dizziness or lightheadedness during physical activity?
•	•	D Shortness of breath at rest?
•	•	E Loss of consciousness/fainting for any reason?
•	•	F Concussion?
•	•	2 Do you currently have pain or swelling in any part of your body (such as from an injury, acute flare-up of arthritis, or back pain) that affects your ability to be physically active?
•	•	3 Has a health care provider told you that you should avoid or modify certain types of physical activity?
•	•	4 Do you have any other medical or physical condition (such as diabetes, cancer, osteoporosis, asthma, spinal cord injury) that may affect your ability to be physically active?
<p>..... ➤ NO to all questions: go to Page 2 – ASSESS YOUR CURRENT PHYSICAL ACTIVITY ➤</p> <p>YES to any question: go to Reference Document – ADVICE ON WHAT TO DO IF YOU HAVE A YES RESPONSE ... ➤➤</p>		

ASSESS YOUR CURRENT PHYSICAL ACTIVITY

Answer the following questions to assess how active you are now.

- 1 During a typical week, on how many days do you do moderate- to vigorous-intensity aerobic physical activity (such as brisk walking, cycling or jogging)? DAYS/
WEEK
 - 2 On days that you do at least moderate-intensity aerobic physical activity (e.g., brisk walking), for how many minutes do you do this activity? MINUTES/
DAY
- For adults, please multiply your average number of days/week by the average number of minutes/day: MINUTES/
WEEK

Canadian Physical Activity Guidelines recommend that adults accumulate at least 150 minutes of moderate- to vigorous-intensity physical activity per week. For children and youth, at least 60 minutes daily is recommended. Strengthening muscles and bones at least two times per week for adults, and three times per week for children and youth, is also recommended (see csep.ca/guidelines).



GENERAL ADVICE FOR BECOMING MORE ACTIVE

Increase your physical activity gradually so that you have a positive experience. Build physical activities that you enjoy into your day (e.g., take a walk with a friend, ride your bike to school or work) and reduce your sedentary behaviour (e.g., prolonged sitting).

If you want to do **vigorous-intensity physical activity** (i.e., physical activity at an intensity that makes it hard to carry on a conversation), and you do not meet minimum physical activity recommendations noted above, consult a Qualified Exercise Professional (QEP) beforehand. This can help ensure that your physical activity is safe and suitable for your circumstances.

Physical activity is also an important part of a healthy pregnancy.

Delay becoming more active if you are not feeling well because of a temporary illness.



DECLARATION

To the best of my knowledge, all of the information I have supplied on this questionnaire is correct.
If my health changes, I will complete this questionnaire again.

I answered **NO** to all questions on Page 1



Sign and date the Declaration below



I answered **YES** to any question on Page 1

Check the box below that applies to you:

- ☐ I have consulted a health care provider or Qualified Exercise Professional (QEP) who has recommended that I become more physically active.
- ☐ I am comfortable with becoming more physically active on my own without consulting a health care provider or QEP.

Trent Monkman

Name (+ Name of Parent/Guardian if applicable) (Please print)

Trent Monkman

Signature (or Signature of Parent/Guardian if applicable)

09/17/98

Date of Birth

02/09/19

Date

Email (optional)

Telephone (optional)

With planning and support you can enjoy the benefits of becoming more physically active. A QEP can help.

☐

Check this box if you would like to consult a QEP about becoming more physically active.
(This completed questionnaire will help the QEP get to know you and understand your needs.)

Appendix C
Informed Consent Forms
Informed Consent

I, the undersigned, do hereby acknowledge:

- my consent to perform a fitness appraisal consisting of the measurement of heart rate, blood pressure, height, weight, maximal or near-maximal exercise (walking, stepping, cycling, running), girths, widths, skin fold thickness, body adiposity using bioelectrical impedance, sprinting, jumping, sit-ups, push-ups, grip strength, leg-extension, age, height, and weight;
- my consent to answer questions concerning my physical activity participation and my lifestyle;
- my understanding that there are potential risks; i.e. episodes of transient lightheadedness, loss of consciousness, abnormal blood pressure, chest discomfort, leg cramps, and nausea, and that I assume willfully those risks;
- my obligation to immediately inform the appraiser of any pain, discomfort, fatigue, or any other symptoms that I may suffer during and immediately after the appraisal;
- my understanding that I may stop or delay any further testing if I so desire and that the appraisal may be terminated by the appraiser upon observation of any symptoms of undue distress or abnormal response;
- my understanding that I may ask any questions or request further explanation or information about the procedures at any time before, during, and after the appraisal;
- that I have read, understood and completed the Physical Activity Readiness Questionnaire (PAR-Q+) and answered NO to all of the questions or received clearance to participate from my physician.

Ashlyn Day	Ashlyn Day	Feb 10 th , 2019
Name (please print)	Signature	Date

Hannah Walline	Hannah Walline	Feb 10 th , 2019
Witness Name (please print)	Signature	Date

Informed Consent

I, the undersigned, do hereby acknowledge:

- my consent to perform a fitness appraisal consisting of the measurement of heart rate, blood pressure, height, weight, maximal or near-maximal exercise (walking, stepping, cycling, running), girths, widths, skin fold thickness, body adiposity using bioelectrical impedance, sprinting, jumping, sit-ups, push-ups, grip strength, leg-extension, age, height, and weight;
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- my understanding that there are potential risks; i.e. episodes of transient lightheadedness, loss of consciousness, abnormal blood pressure, chest discomfort, leg cramps, and nausea, and that I assume willfully those risks;
- my obligation to immediately inform the appraiser of any pain, discomfort, fatigue, or any other symptoms that I may suffer during and immediately after the appraisal;
- my understanding that I may stop or delay any further testing if I so desire and that the appraisal may be terminated by the appraiser upon observation of any symptoms of undue distress or abnormal response;
- my understanding that I may ask any questions or request further explanation or information about the procedures at any time before, during, and after the appraisal;
- that I have read, understood and completed the Physical Activity Readiness Questionnaire (PAR-Q+) and answered NO to all of the questions or received clearance to participate from my physician.

Eric Hegadoren	Eric Hegadoren	Feb 10 th , 2019
Name (please print)	Signature	Date

Trent Monkman	Trent Monkman	Feb 10 th , 2019
Witness Name (please print)	Signature	Date

Informed Consent

I, the undersigned, do hereby acknowledge:

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- my understanding that there are potential risks; i.e. episodes of transient lightheadedness, loss of consciousness, abnormal blood pressure, chest discomfort, leg cramps, and nausea, and that I assume willfully those risks;
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- my understanding that I may ask any questions or request further explanation or information about the procedures at any time before, during, and after the appraisal;
- that I have read, understood and completed the Physical Activity Readiness Questionnaire (PAR-Q+) and answered NO to all of the questions or received clearance to participate from my physician.

Hannah Walline	Hannah Walline	Feb 10 th , 2019
Name (please print)	Signature	Date

Kayla Krug	Kayla Krug	Feb 10 th , 2019
Witness Name (please print)	Signature	Date

Informed Consent

I, the undersigned, do hereby acknowledge:

- my consent to perform a fitness appraisal consisting of the measurement of heart rate, blood pressure, height, weight, maximal or near-maximal exercise (walking, stepping, cycling, running), girths, widths, skin fold thickness, body adiposity using bioelectrical impedance, sprinting, jumping, sit-ups, push-ups, grip strength, leg-extension, age, height, and weight;
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- my understanding that there are potential risks; i.e. episodes of transient lightheadedness, loss of consciousness, abnormal blood pressure, chest discomfort, leg cramps, and nausea, and that I assume willfully those risks;
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- my understanding that I may stop or delay any further testing if I so desire and that the appraisal may be terminated by the appraiser upon observation of any symptoms of undue distress or abnormal response;
- my understanding that I may ask any questions or request further explanation or information about the procedures at any time before, during, and after the appraisal;
- that I have read, understood and completed the Physical Activity Readiness Questionnaire (PAR-Q+) and answered NO to all of the questions or received clearance to participate from my physician.

Justin McChesney	Justin McChesney	Feb 10 th , 2019
Name (please print)	Signature	Date

Eric Hegadoren	Eric Hegadoren	Feb 10 th , 2019
Witness Name (please print)	Signature	Date

Informed Consent

I, the undersigned, do hereby acknowledge:

- my consent to perform a fitness appraisal consisting of the measurement of heart rate, blood pressure, height, weight, maximal or near-maximal exercise (walking, stepping, cycling, running), girths, widths, skin fold thickness, body adiposity using bioelectrical impedance, sprinting, jumping, sit-ups, push-ups, grip strength, leg-extension, age, height, and weight;
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- my understanding that there are potential risks; i.e. episodes of transient lightheadedness, loss of consciousness, abnormal blood pressure, chest discomfort, leg cramps, and nausea, and that I assume willfully those risks;
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- my understanding that I may ask any questions or request further explanation or information about the procedures at any time before, during, and after the appraisal;
- that I have read, understood and completed the Physical Activity Readiness Questionnaire (PAR-Q+) and answered NO to all of the questions or received clearance to participate from my physician.

Kayla Krug	Kayla Krug	Feb 10 th , 2019
Name (please print)	Signature	Date

Ashlyn Day	Ashlyn Day	Feb 10 th , 2019
Witness Name (please print)	Signature	Date

Informed Consent

I, the undersigned, do hereby acknowledge:

- my consent to perform a fitness appraisal consisting of the measurement of heart rate, blood pressure, height, weight, maximal or near-maximal exercise (walking, stepping, cycling, running), girths, widths, skin fold thickness, body adiposity using bioelectrical impedance, sprinting, jumping, sit-ups, push-ups, grip strength, leg-extension, age, height, and weight;
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- my understanding that I may ask any questions or request further explanation or information about the procedures at any time before, during, and after the appraisal;
- that I have read, understood and completed the Physical Activity Readiness Questionnaire (PAR-Q+) and answered NO to all of the questions or received clearance to participate from my physician.

Trent Monkman	Trent Monkman	Feb 10 th , 2019
Name (please print)	Signature	Date

Justin McChesney	Justin McChesney	Feb 10 th , 2019
Witness Name (please print)	Signature	Date

Are YOU Tough Enough?

Can a varsity basketball skill-set translate to success in American Ninja Warrior?

Participant Questionnaire and Feedback Form

Name: Trent Monkman

Date: Mar. 14th, 2019

1. Have you ever watched American Ninja Warrior?

Yes

No

2. How much did you enjoy the experiment and participating in the tests?

Not at all

1

2

Average

3

4

Very well

5

3. How well did the researchers inform you about the purpose of each experiment?

Not at all

1

2

Average

3

4

Very well

5

4. How prepared were the researchers before, during, and after the experiments?

Not at all

1

2

Average

3

4

Very well

5

5. Comments on what you enjoyed most about the experience, researchers, or anything in general?

It was cool too see my own stats, especially from the beginning of the season. Some of the tests I never have seen or was too familiar with, so that was interesting to try some other techniques out.

6. Comments on what you think could be improved or changed with the tests, feedback/critique for the researchers, or anything in general?

Since the show has so much upper body movement challenges, would have been cool if somehow there was a swinging test, or a jump with a catch to hang involved like the show!

THANK YOU FOR YOUR PARTICIPATION!

Are YOU Tough Enough?

Can a varsity basketball skill-set translate to success in American Ninja Warrior?

Participant Questionnaire and Feedback Form

Name: Ashlyn Day

Date: March 17th, 2018

1. Have you ever watched American Ninja Warrior?

Yes

No

2. How much did you enjoy the experiment and participating in the tests?

Not at all

1

2

Average

3

4

Very well

5

3. How well did the researchers inform you about the purpose of each experiment?

Not at all

1

2

Average

3

4

Very well

5

4. How prepared were the researchers before, during, and after the experiments?

Not at all

1

2

Average

3

4

Very well

5

5. Comments on what you enjoyed most about the experience, researchers, or anything in general?

It was fun to see how fast other people were able to run the obstacle course, and the course was well made.

6. Comments on what you think could be improved or changed with the tests, feedback/critique for the researchers, or anything in general?

All of the tests were interesting and worked well!

THANK YOU FOR YOUR PARTICIPATION!

Are YOU Tough Enough?

Can a varsity basketball skill-set translate to success in American Ninja Warrior?

Participant Questionnaire and Feedback Form

Name: Hannah Walline

Date: Mar.17/19

1. Have you ever watched American Ninja Warrior?

Yes No

2. How much did you enjoy the experiment and participating in the tests?

Not at all		Average		Very well
1	2	3	4	5

3. How well did the researchers inform you about the purpose of each experiment?

Not at all		Average		Very well
1	2	3	4	5

4. How prepared were the researchers before, during, and after the experiments?

Not at all		Average		Very well
1	2	3	4	5

5. Comments on what you enjoyed most about the experience, researchers, or anything in general?

I liked comparing my results against other people. I had a lot of fun doing the obstacle course!

6. Comments on what you think could be improved or changed with the tests, feedback/critique for the researchers, or anything in general?

All of the tests were easy to understand and participate in. Great experience overall.

THANK YOU FOR YOUR PARTICIPATION!

Are YOU Tough Enough?

Can a varsity basketball skill-set translate to success in American Ninja Warrior?

Participant Questionnaire and Feedback Form

Name: Justin McChesney

Date: Mar. 15th, 2019

1. Have you ever watched American Ninja Warrior?

Yes

No

2. How much did you enjoy the experiment and participating in the tests?

Not at all

1

2

Average

3

4

Very well

5

3. How well did the researchers inform you about the purpose of each experiment?

Not at all

1

2

Average

3

4

Very well

5

4. How prepared were the researchers before, during, and after the experiments?

Not at all

1

2

Average

3

4

Very well

5

5. Comments on what you enjoyed most about the experience, researchers, or anything in general?

Vertical test was the best

6. Comments on what you think could be improved or changed with the tests, feedback/critique for the researchers, or anything in general?

Maybe start with the obstacle course, since it seemed the most consistent with the actual show, then the other tests would follow nicely. But was still fun

THANK YOU FOR YOUR PARTICIPATION!

Are YOU Tough Enough?

Can a varsity basketball skill-set translate to success in American Ninja Warrior?

Participant Questionnaire and Feedback Form

Name: Kayla Krug

Date: March 17th 2019

1. Have you ever watched American Ninja Warrior?

Yes

No

2. How much did you enjoy the experiment and participating in the tests?

Not at all

1

2

Average

3

4

Very well

5

3. How well did the researchers inform you about the purpose of each experiment?

Not at all

1

2

Average

3

4

Very well

5

4. How prepared were the researchers before, during, and after the experiments?

Not at all

1

2

Average

3

4

Very well

5

5. Comments on what you enjoyed most about the experience, researchers, or anything in general?

The obstacle course was very well made, they did a good job of making it tiring enough, but also fun. Everything went really well.

6. Comments on what you think could be improved or changed with the tests, feedback/critique for the researchers, or anything in general?

Everything was great!

THANK YOU FOR YOUR PARTICIPATION!

Are YOU Tough Enough?

Can a varsity basketball skill-set translate to success in American Ninja Warrior?

Participant Questionnaire and Feedback Form

Name: Eric Hegadoren

Date: Mar. 16th, 2019

1. Have you ever watched American Ninja Warrior?

Yes No

2. How much did you enjoy the experiment and participating in the tests?

Not at all		Average		Very well
1	2	3	4	5

3. How well did the researchers inform you about the purpose of each experiment?

Not at all		Average		Very well
1	2	3	4	5

4. How prepared were the researchers before, during, and after the experiments?

Not at all		Average		Very well
1	2	3	4	5

5. Comments on what you enjoyed most about the experience, researchers, or anything in general?

I can jump higher than Justin

6. Comments on what you think could be improved or changed with the tests, feedback/critique for the researchers, or anything in general?

THANK YOU FOR YOUR PARTICIPATION!

Appendix E
Raw Data

Table E1.

Participant Base Measurement Data

Participant	Height (cm)	Weight (kg)	Wingspan (cm)	Resting HR (bpm)	Resting Blood Pressure (mmHg)
P1	184	80.5	193	60	112/78
P2	206.5	112.5	221	66	118/82
P3	204	100	211.5	68	122/86
P4	177	66.5	178	56	110/72
P5	164	67	159	68	116/78
P6	177.5	74.5	178	64	122/68

Table E2.

Queen's College Step Test

Participant	Time (s)	HR (bpm)	Estimated VO2
P1	180	120	60.9
P2	180	140	52.5
P3	180	132	55.9
P4	180	174	33.7
P5	180	138	40.3
P6	180	198	29.2

Table E3.

American Ninja Warrior Simulation Skills

Participant	70 m Obstacle Course (s)	Max Rep Pull-ups (pronated)	Max Hang Time (s)	Grip Test (kg)	Vertical Jump (cm [Watts])	Sit and Reach (cm)	Shoulder Flexibility (degrees)
P1	30.55	13	56.17	118.0	76 [6205]	32.0	R: 246 L: 241
P2	33.03	8	48.82	143.5	72 [7412]	43	R: 249 L: 252
P3	34.54	9	66.02	131.0	70 [6724]	23	R: 221 L: 218
P4	41.08	0	56.68	64.0	41.5 [3477]	12.5	R: 217 L: 232
P5	36.71	0	55.99	59.0	57 [4440]	29	R: 249.5 L: 245.5
P6	34.63	2	74.28	69.0	44 [3991]	11.0	R: 240.5 L: 237