Continuation/Research Progression Projects Form (7)

Required for projects that are a continuation/progression in the same field of study as a previous project.
This form must be accompanied by the previous year's abstract and Research Plan/Project Summary.

Student's Name(s) Josh Cooper

To be completed by Student Researcher: List all components of the current project that make it new and different from previous research. The information must be on the form; use an additional form for previous year and earlier projects.

Components	Current Research Project	Previous Research Project: Year: 2018
1. Title	Impact of the shock absorption properties of basketball shoe cushioning systems on the likelihood of lower extremity overuse injuries	Impact of various basketball shoe cushioning systems on overuse injury
2. Change in goal/ purpose/objective	Purpose was to determine the correlation between shock absorption levels measured in Phase 1 and the likelihood of overuse lower extremity injuries.	Purpose was to determine the relative shock absorption levels of the four basketball shoe cushions.
3. Changes in methodology	My current research project involves Phase 1 and Phase 2 of my study. Phase 2 of the study involved five participants performing jump landings in the four different basketball shoes. Forde was measured using Loadsol	The previous research project only involved Phase 1 of the study, which consisted of a drop test where four basketball shoe cushions were evaluated for their relative shock absorption capabilities.
4. Variable studied	Amount of force on the foot (measured by the Loadsol insoles).	Relative shock asborption levels of the four baksetball shoe cushions.
5. Additional changes		

Attached are:

☑ Abstract and Research Plan/Project Summary, Year 2018

I hereby certify that the above information is correct and that the current year Abstract & Certification and project display board properly reflect work done only in the current year.

Josh Cooper	JCoop	12/12/19
Student's Printed Name(s)	Signature	Date of Signature (mm/dd/yy)

2018 Research Plan
Date: 11/25/18
Title: Impact of various basketball shoe cushioning systems on overuse injury rates

1. All projects must have a Research Plan/Project Summary

a. Written prior to experimentation following the instructions below to detail the rationale, research question(s), methodology, and risk assessment of the proposed research.

b. If changes are made during the research, such changes can be added to the original research plan as an addendum, recognizing that some changes may require returning to the IRB or SRC for appropriate review and approvals. If no additional approvals are required, this addendum serves as a project summary to explain research that was conducted.

c. If no changes are made from the original research plan, no project summary is required.

2. Some studies, such as an engineering design or mathematics projects, will be less detailed in the initial project plan and will change through the course of research. If such changes occur, a project summary that explains what was done is required and can be appended to the original research plan.

3. The Research Plan/Project Summary should include the following:

a. RATIONALE: Include a brief synopsis of the background that supports your research problem and explain why this research is important and if applicable, explain any societal impact of your research. (include studies that I read that helped me arrive at my research)

Over 1 billion people in the world play sports. With this high level of participation, many injuries occur. While some are more severe than others, injuries prevent an athlete from playing his/her sport. The majority of sports injuries involve the lower body (lower extremity injuries). In almost all sports, participants wear sneakers, which can help protect from injuries. Several studies have been completed that have examined the relationship between athletic sneakers and injuries and performance. In one study, the height, weight and flexibility of shoes were tested to measure athletic performance (Blache, Beguin, & Monteil, 2011). In a second study, different heights of shoes (high-top vs low-top) were tested against each other to determine injury rates. It was determined that high-top shoes reduce the prospect of ankle injuries compared to low-top shoes (Ricard, Schulties & Saret 2000). As a high school basketball player with first hand experience with the impact on the body of daily activity, I understand that overuse injuries are common. In an attempt to address this issue, I decided to focus my study specifically on the cushioning systems of basketball shoes to determine which materials prevent injuries most effectively.

b. RESEARCH QUESTION(S), HYPOTHESIS(ES), ENGINEERING GOAL(S), EXPECTED OUTCOMES: How is this based on the rationale described above?

Research Question(s):

- What is the optimal cushioning system in a basketball shoe for an athlete to reduce the chance of overuse lower extremity injuries?
- How does the force distribution, pressure and shock absorption of basketball shoes relate to lower extremity injury rates? (for ex. Does increased shock absorption result in lower injury rates?)

Goal(s):

- Determine the shock absorption and energy return of specific cushioning systems.
- Hypothesize a correlation between shock absorption and energy return and injury rates.

Hypotheses:

- The cushion that absorbs shock the best (in bench study) will minimize the force impact on the foot during the lab simulation.
- It is most favorable for overuse injury prevention to have a cushioning system with increased shock absorption because it will minimize the force put on the foot.

c. Describe the following in detail: • Procedures: Detail all procedures and experimental design including methods for data collection. Describe only your project. Do not include work done by mentor or others. • Risk and Safety: Identify any potential risks and safety precautions needed. • Data Analysis: Describe the procedures you will use to analyze the data/results.

I plan to perform three different studies as part of my overall research. In my bench study, I will find the shock absorption and energy return of four specific basketball cushioning systems by completing a drop test

- Drop Test
    - Evaluating cushioning systems for energy return and shock absorption.
    - I will drop a ball from a specific height and record the height that the ball bounces off of the cushion.
    - A higher bounce correlates to more energy return and less shock absorption. Conversely, a lower bounce correlates to less energy return and a greater amount of shock absorption.
    - This will establish the relative level of shock absorption in each of the four shoes tested.

For the second phase of my study (Lab Simulation), I will go into a lab and use advanced equipment (in-shoe technology and a force plate) to measure force distribution and pressure patterns on the foot while wearing each shoe.

- Lab Simulation
    - Utilize four unique basketball shoes, with varying cushioning systems
    - The Lab Simulation with measure the force on my foot while wearing each basketball shoe through two different testing mechanisms
        - Insoles with sensors
        - A force plate

- Wearing the shoes with the insoles, I will perform several jump landings to collect data regarding the distribution of force on various parts of my foot
- I will repeat the test by jumping onto the force plate
- All testing in the lab will be performed under the supervision of lab staff and one of my mentors (either Dr. Howard Hillstrom or Professor Ben Johnson) to ensure safety during the lab testing.

The last part of my study will be my literature study. By reading journal articles and researching, I will determine the correlation between the various characteristics of basketball shoe cushions (shock absorption, energy return, force distribution, pressure patterns) and injury rates.

d. BIBLIOGRAPHY: List major references (e.g. science journal articles, books, internet sites) from your literature review. If you plan to use vertebrate animals, one of these references must be an animal care reference.

Blache, Y., Beguin, A., & Monteil, K. (2011). Effects of various parameters of basketball shoes on vertical jumping performance: A case study. Science & Sports,26(1), 48-50. doi:10.1016/j.scispo.2010.08.007

Ricard, M. D., Schulties, S. S., & Saret, J. J. (2000). Effects of High-Top and Low-Top Shoes on Ankle Inversion. Journal of Athletic Training, 38-43.

Chen, Chia-Hsiang, et al. "Effects of Forefoot Bending Elasticity of Running Shoes on Gait and Running Performance." Human Movement Science, vol. 38, 2014, pp. 163–172., doi:10.1016/j.humov.2014.10.002.

Da Silva, R. M., & Rodrigues, J. L. (2009). Evaluation of shock absorption properties of rubber materials regarding footwear applications. Polymer Testing, 28(6)

Items 1–4 below are subject-specific guidelines for additional items to be included in your research plan/project summary as applicable.

1. Human participants research:

a. Participants: Describe age range, gender, racial/ethnic composition of participants. Identify vulnerable populations (minors, pregnant women, prisoners, mentally disabled or economically disadvantaged).

- The only time that there will be a participant in my study is during the Lab Simulation portion of my study. I will be the only participant in my study.
    - 16 years old, male, white, no vulnerable populations.

b. Recruitment: Where will you find your participants? How will they be invited to participate?

- I will be the only participant. There will be no need for recruitment.

c. Methods: What will participants be asked to do? Will you use any surveys, questionnaires or tests? If yes and not your own, how did you obtain? Did it require permissions? If so, explain. What is the frequency and length of time involved for each subject?

- I will go to a lab and perform jump tests utilizing in-sole technology and a force plate. I will perform this test wearing four different types of basketball shoes.
- I will perform these test utilizing standard equipment at either the Hospital of Special Surgery at the Leon Root Motion Analysis Lab or the University of Kentucky Biomechanics Laboratory.
- The tests will be supervised by lab staff

d. Risk Assessment: What are the risks or potential discomforts (physical, psychological, time involved, social, legal, etc.) to participants? How will you minimize risks? List any benefits to society or participants.

- A very small amount of risk is involved. I will land from jumps in four basketball shoes that all provide ample support. The jump landings will be normal landings that I perform in normal athletic movements.
- The tests will utilize standard equipment and will be supervised by lab staff.

e. Protection of Privacy: Will identifiable information (e.g., names, telephone numbers, birth dates, email addresses) be collected? Will data be confidential/anonymous? If anonymous, describe how the data will be collected. If not anonymous, what procedures are in place for safeguarding confidentiality? Where will data be stored? Who will have access to the data? What will you do with the data after the study?

- No personal data/information will be collected because I am the only participant.

f. Informed Consent Process: Describe how you will inform participants about the purpose of the study, what they will be asked to do, that their participation is voluntary and they have the right to stop at any time.

- Since I am the only participant, I understand the purpose of the study, as well as what I will be asked to do.

WESEF 2018

Abstract

Performance basketball shoe cushioning systems are designed to balance two key characteristics: shock absorption and energy return. A greater amount of shock absorption is intended for injury prevention while increased energy return allows for better performance. This study focuses on the shock absorption capabilities of the cushioning system as a key factor in injury prevention. The purpose of this study is to determine the relationship between shock absorption properties of basketball shoe cushions and the likelihood of overuse injury rates. The methodology includes two phases. In phase one, the shock absorption capability of four basketball shoe cushioning systems was tested in a "Drop Test." A cylindrical 176.2 gram metal weight was dropped onto an apparatus which put force onto the heel of deconstructed cushions from four different basketball shoe models. A force platform measured the intensity of the force, which established the relative shock absorption capabilities of the four cushioning systems. The results of the test demonstrated with statistical significance that the shock absorption capability of the Nike Zoom Shift cushioning system is inferior to that of the AND1 Tai Chi, AND1 Attack and Nike Lebron 16. The second phase of the study will determine the relationship between shock absorption properties and the likelihood of overuse injuries. Data will be collected using advanced insole technology to determine the amount of force applied to the foot in the four basketball shoes utilizing the cushioning systems featured in Phase one. Since increased amounts of force put on the foot over time is a key driver of overuse injuries, the results from the two phases in the study will be compared to determine if greater shock absorption capability of the cushioning system leads to less force put on the foot, and therefore, a lower likelihood of overuse injuries.