Appendix

CEHD International Collaborative Research Grant Application Form

Submit this application form by one of the following due dates along with your proposal. Applications must be received, at tate-center@wmich.edu, by 5:00 p.m. on August 15, November 15, March 15, and June 15.

Application					
Applicant Name: Sangwoo Lee					
Title: Assistant Professor					
Department: HPHE					
Title of Proposal: A biomechanical comparison of experimentally controlled and self-selected speeds and grip widths during the bench press exercise					
Amount Requested: $2,982.5 from WMU and $3,000 from the non-US collaborative institution					
Dates of Project: May 1, 2019 – April 30, 2020					
Evaluation Guidelines					
Strongly Agree 5	**Agree 4**	**Undecided 3**	**Disagree 2**	**Strongly Disagree 1**	
The project purpose is clear.	5	4	3	2	1
The project has a solid literature base.	5	4	3	2	1
The proposed project has a detailed and feasible work plan.	5	4	3	2	1
The proposed project has a potential to yield research publications, external funding, and/or enrollment increases.	5	4	3	2	1
There is evidence for at least $3,000 matching fund from a non-US collaborative institution.	5	4	3	2	1
The costs for the proposed budget are clearly itemized and justified (including the matching funds from the non-US collaborative institution).	5	4	3	2	1

A BIOMECHANICAL COMPARISON OF EXPERIMENTALLY CONTROLLED AND SELF-SELECTED SPEEDS AND GRIP WIDTHS DURING THE BENCH PRESS EXERCISE

BACKGROUND

The bench press exercise (BP) is an upper body strength training exercise. Lifters lying down on a bench lower the bar to touch the chest at approximately nipple level and push the bar upward and slightly backward until the elbows are fully extended [1]. The BP works primarily the pectoralis major, anterior deltoid, and triceps brachii muscles [1]. The BP has been considered a popular strength training exercise among recreationally trained lifters as well as professional athletes due to its benefits [2,3]. The benefits are the improvement of muscular strength, power, size, and endurance depending on how lifters vary training load, the number of repetitions and sets, and resting periods [1].

Several movement variations of the BP exist [2-13], so it is often observed in a gym that lifters perform the BP in different ways. A study reviewed how variations of the BP significantly changed the primary muscle activities during the BP [2]. The study indicated that the speed of movement was one of the significant factors that changed the muscle activities. Another study also revealed that the speed of movement during the BP can be considered a fundamental component of resistance training variation, since for a given load the speed of movement largely determines the resulting training effect [12]. This speed variation may be attributable to targeting different training goals. For example, a slow speed is recommended for technique acquisition while a fast speed needs to be used to increase the muscle strength and repetitions [10,11,13]. In addition to the speed of movement, a grip width is often observed as a BP variation. There have been studies that examined the effects of grip widths on 1 repetition maximum (1RM, the maximum weight one can lift once for an exercise) and muscle activities during the BP [3-5,8,9]. The findings of the studies showed that 1RM increased as the grip width increased up to a certain level, and muscle activities were significantly changed as the grip width varied.

A common methodological problem observed in many of experimental studies that have examined the effects of the variations of a given movement has not considered participants' self-selected conditions [3-12]. Different experimental conditions of the speed of movement and grip width were determined mainly based on external factors such as a metronome and shoulder width. A metronome was used to control the speed of movement and a biacromial distance (BAD, the distance between acromion processes) was used to control the grip width despite their potential effect causing the unnaturalness of movement. According to a study [14], the participants reported unnaturalness when their movements were experimentally controlled by a metronome while performing a resistance exercise. Besides the controlled speed, lifters are likely to feel uncomfortable if they are asked to change the grip width for the BP especially when they lift heavy loads. Thus, different results would be derived when lifters use their self-selected speed and grip width from when they use experimentally controlled ones. The results obtained from the experimentally controlled speed and grip may not be well-

applicable to the real world. Nevertheless, most of the previous studies did not include self-selected speed and grip width into their experimental conditions.

It is generally thought that participants would feel the most comfortable with their self-selected speed and grip width during the BP. Thus, the self-selected conditions would produce different 1RM and muscle activity from the experimentally controlled conditions during the BP. Furthermore, little is known about an interaction between the speed of movement and the grip width during the BP although there would be a potential interaction between them during the BP.

PURPOSE

Therefore, the purpose of this study is to compare 1RM and muscle activity between experimentally controlled and self-selected speeds and grip widths during the BP.

HYPOTHESIS

1. The self-selected speed would show significantly different 1RM and muscle activity from the experimentally controlled speed during the BP.
2. The self-selected grip width would show significantly different 1RM and muscle activity from the 200% BAD grip width during the BP.
3. There would be a significant interaction between a speed of movement and a grip width during the BP.

METHODS

Participants

A total of 40 recreationally trained lifters between the ages of 20 - 30 years will be recruited for this study. Since this project will be a collaborative research project, 20 participants will be recruited from Western Michigan University and the non-US collaborative institution, respectively. Only healthy males will be recruited to eliminate the influence of gender-induced heterogeneity. The general inclusion criteria will be 1) at least 3 years of prior BP experience, 2) no upper extremity joint injury history at least 12 months prior to this study, and 3) ability to perform the BP with an appropriate posture.

Substantial physical discrepancies, such as different arm lengths and chest depth, can be a significant confounding factor for 1RM during the BP [9]. Therefore, the participants' physical inclusion criteria will be 1) height between 170 and 180 cm and 2) body mass index (body mass/height^2) between 18.5 and 24.9 kg/m^2. Prior to the initiation of the study, the participants will be informed of the purposes of this study and asked to sign an informed consent form approved by university Institutional Review Board.

Procedures

Four 1RM measurements will be performed with: 1) a self-selected grip width at an experimentally controlled speed, 2) a self-selected grip width at a self-selected speed, 3) a 200% of BAD grip width at an experimentally controlled speed, and 4) a 200% of BAD gripwidth at a self-selected speed. Each 1RM test will be conducted on a day, and at least 48 hours will be provided to the participants for recovery before the next 1RM measurement. 1RM testing protocol recommended by the National Strength and Conditioning Association (NSCA) will be used for the 1RM measurement [1].

One week later, participants will return for data collection of the bar movement and muscle activity. Participants will perform multiple warm-up BP trials with all 4 conditions. The warm-up consists of 8 trials of each condition with a weighted barbell (20.4 kg) followed by 4 repetitions of each condition with the barbell plus additional weight plates (61.2 kg). Each participant will perform a total of 20 BP trials (4 conditions × 5 trials per condition) in a randomized order to prevent any order effects. The weight for each condition will be 85% 1RM of each condition. A minimum rest period of 2 minutes between trials will be allowed to minimize fatigue.

Justification of Speed Selection

Although BP performance, such as 1RM and the number of repetitions, increases as the speed of movement increases during the BP [10,12,13], a fast speed will not be selected as the experimentally controlled condition in this study due to its impracticableness. The experimentally controlled speed to be used will be determined based on pilot 1 RM tests from 3 volunteers. The speed determined will then be controlled using a metronome during testing. A self-selected speed will be selected because lifters generally feel the most comfortable to lift at this speed during the BP.

Justification of Grip Width Selection

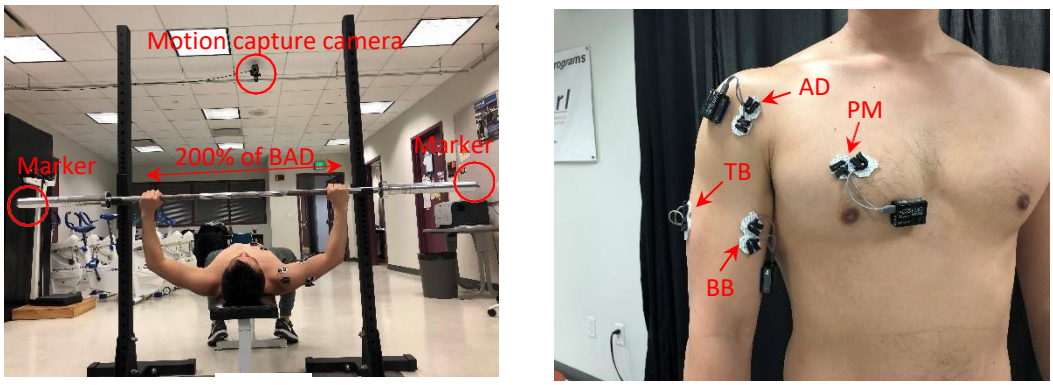
200% of BAD grip width will be selected in this study since 200% of BAD grip width is expected to show a maximum muscular strength and muscle activation [5,9]. More specifically, 200% of BAD grip width showed the greatest 1RM value across various grip width conditions of 95, 130, 165, 200, 235, and 270% of BAD grip width [9]. The study conducted by Clemons [5] also indicated that 190 % of BAD showed the greatest muscle activation among 100, 130, 165, and 190% of BAD. The study also reported that grip widths greater than 200% of BAD have not been shown to be any more effective. A self-selected grip will be selected because lifters generally feel the most comfortable to lift with this grip during the BP.

Experimental Setup and Data Analysis

Two markers (i.e. sphere-shaped plastic balls) will be attached to the bar (one on each side) to create the bar as a stick figure. A three-dimensional (3D) motion capture system (Model Bonita 3 and 10; VICON, Centennial, CO, USA) will be used to capture the markers attached (Figure 1a). The stick figure of the bar created will then be used to examine the vertical movement (i.e.

vertical acceleration) of the bar. This procedure needs to be conducted because understanding how lifters move the bar vertically would provide more in-depth data interpretation of muscle activities. The vertical acceleration data will be collected using a 3-axis accelerometer at the non-US collaborative institution.

A wireless surface electromyography (EMG) system (Desktop DTS; Noraxon, AZ, USA) will be used to collect the myoelectric activities of the predetermined muscles. 4 muscle groups, including pectoralis major (PM), triceps brachii lateral head (TB), anterior deltoid (AD), and biceps brachii (BB), will be selected for this study (Figure 1b). Surface electrodes (2 cm × 2 cm) will be unilaterally attached to the above-mentioned muscles on each participant's right side. Prior to electrode placement, the skin will be cleaned with an alcohol swab and gently shaved using a razor to ensure that the resistance between the skin and the electrode is low. The locations of the electrodes will be determined based on a 3D muscle map provided by the EMG analysis software (MyoMuscle MR3 3.8.6; Noraxon, AZ, USA).



(a) (b)

Figure 1. (a) 3D motion capture system and grip width condition; (b) electrode placement

Statistical Analysis

A 2-way repeated measures analysis of variance (ANOVA) will be performed with speed of movement (within: self-selected speed and experimentally controlled speed) and grip width (within: self-selected grip width and 200% of BAD grip width) being the independent variables. In order to examine the muscular strength and the muscle activities of the upper extremity during the BP, the dependent variables will be 1RM and the muscle activities of PM, TB, AD, and BB. Statistical analyses will be conducted using IBM SPSS Statistics version 19 (IBM, New York) with α level set at .05.

SIGNIFICANCE OF THE STUDY

The current study is developed to bridge the gap from the scientific laboratory to the field practitioner. It is expected that more practical and applicable results to the real world will be

derived from this study according to the purpose of this study. Therefore, the findings of this study will be used to make significant contributions to the area of strength and conditioning focusing on helping both recreationally trained lifters and athletes improve their athletic performance and reduce the likelihood of the upper body injury during the BP. The completion of this project is believed to provide preliminary data for a larger-scale future funding proposal directed toward Young Investigator Grant funded by National Strength and Conditioning Association. The maximum award is $20,000 plus indirect costs at a rate of up to 20%.

REFERENCES

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WORK PLAN

May, 2019	On-Site Visit to the Non-US Collaborative Institution
July - August, 2019	Human Subjects Institutional Review Board Approval
September - December, 2019	Data Collection
January - April, 2020	Data Analysis
May, 2020	Final Report Submission

WMU BUDGET AND JUSTIFICATION

(Redacted)

THE NON-US COLLABORATIVE INSTUTITION BUDGET AND JUSTIFICATION

(Redacted)

Dear Western Michigan University-College of Education and Human Development,

It is our pleasure to be a partner for Western Michigan University (WMU)'s College of Education and Human Development (CEHD) International Collaborative Research Grant Program. Through this partnership, a collaborative research initiative will be established between Department of Rehabilitation Personal Training at Konyang University (KU) in South Korea and Exercise Science program in Department of Human Performance and Health Education at WMU in the United States.

The project entitled "A biomechanical comparison of experimentally controlled and self-selected speeds and grip widths during the bench press exercise" is in line with the mission of our department that focuses on professional training for both athletes and the general population through the principles and methods of rehabilitation training. Dr. Suk-Bum Kim from KU who is the current department chair will be primarily working on this project with Dr. Sangwoo Lee from WMU. According to the guidelines of this research program, a matching fund of $3,000 will be provided from our department which will beused for data collection and analysis.

This research collaboration is highly expected to yield win-win outcomes for both institutions including enrollment increases and external funding as well as research publications. We look forward to being a partner with WMU-CEHD for this international research initiative. If you would like to discuss this research collaboration any further, feel free to email or call me.

Sincerely,

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