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Assessing Worksite Health Promotion Programming and Resource Capacity in Mississippi Community Colleges

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ABSTRACT

Health promotion programs in higher education settings have traditionally focused on the health and well-being of the student population. However, opportunities exist to also utilize the worksite function of these institutions to address employee health and facilitate an economic benefit in local communities. This is especially pertinent in rural communities, which is often the location of community colleges and in locations facing disparities and social determinants-related health challenges such as the state of Mississippi. In this study, basic levels of capacity and current practices related to health promotion in Mississippi's community college system were assessed. A 51-item survey instrument was sent to presidents of all 15 community colleges within the Mississippi community college system via both e-mail and regular mail. The survey instrument was designed to assess existing program offerings and capacity for institutional and community programming to benefit employees while simultaneously providing environments supportive of health promoting activities. Survey results indicated inadequate levels of awareness of the benefits of worksite health promotion while also revealing potential for implementation of these programs as a means of benefitting communities and states from health, well- being and economic perspectives. The case is also made for benefits beyond direct employee health and associated return on investment to also include the role of health enhancement programs in community colleges as economic drivers in local, rural, often underserved communities.

Introduction

Full-time employees spend one-third of most days working, which makes worksites an opportune setting to implement health promotion interventions. Additionally, worksites have shown, with proper programming and appropriate resources in place, the ability to be a setting that directly affects the workers' all-around well-being (Centers for Disease Control and Prevention [CDC], 2017). The desired benefits sought by companies that invest in worksite wellness programs include, but are not limited to, avoidance of surplus expenses associated with treating chronic diseases and demonstrated return on investment. (Baicker Cutler & Song, 2010; Wein, 2015). The Workplace Health in America (2017) results suggest that no worksite size, category, or industry group is at an inherent disadvantage for having a comprehensive health promotion program (CDC, 2017).

The Okanagan Charter (2015) was developed in collaboration with researchers, practitioners, administrators, students and policymakers from 45 countries representing both educational institutions and health organizations and calls on post-secondary schools to embed health into all aspects of campus culture and lead health promotion action and collaboration locally and globally (American College Health Association [ACHA], 2015). This charter emphasizes a proactive approach to health and well-being that moves beyond individual behaviors toward larger social and environmental interventions and reiterates higher education's central role in the ongoing development of individuals, communities, societies, and cultures (Travia, Larcus, Andes, & Gomes, 2020). It is worth noting that while health promotion in higher education settings is often student health focused, these institutions are also worksites for faculty and staff. In some settings, perhaps most notably the community college setting, these institutions are also primary sources of employment and economic drivers, often in rural and underserved communities. Community college systems are located in all US states and offer a built-in dissemination mechanism for effective health-related programming (Linnan, Brooks, Haws, Benedict, Birken, French, Gizlice, & Britt (2010). Community colleges provide an anomalous setting for these programs compared to their larger university counterparts with the potential to see similar positive impacts. A study conducted by Thornton and Johnson (2010), found that 42.2% of community colleges had some type of employee wellness program present. Linnan, Arandia, Naseer, Li, Pomerantz & Diehl (2017) noted that adoption of worksite health in community colleges was related to perceived benefits, challenges, and types of technical assistance and supports. They further noted that mobilizing campus, community, and other partnerships to promote comprehensive health programming will be an important first step in building campus capacity (Linnan et al., 2017).

Overview of Community Colleges in Mississippi

The state of Mississippi currently ranks as the least healthy state in the nation (America's Health Ranking, 2020). Community colleges are often located in hard-to-reach rural areas of states such as Mississippi, where over half the population is rural residents (Rural Health Information Hub, 2018). Community colleges exist on 15 main campuses and numerous outreach locations that reach all 82 counties in the state. Mississippi community colleges employ more than 8,100 people statewide, and typically fall among the top five employers in their respective regions, spending more than $1.2 billion annually in institutional and student expenditures (National Strategic Planning & Analysis Research Center, 2020). Three out of four students attend a community college in their home district and more than 75% of community college graduates (who are non-university-bound) enter employment in the Mississippi labor force within a year of graduating (National Strategic Planning & Analysis Research Center, 2020).

The purpose of this study was to conduct an initial assessment of the potential for worksite health programs at community colleges in Mississippi to improve employee health and function as economic drivers in rural communities.

Methods

Contact information about the presidents of the 15 community colleges in Mississippi were ascertained from the Mississippi Community College Board's website, and a survey, cover letter, and consent form were mailed directly to the offices of the presidents in the Mississippi Community College system. Additionally, a weblink to the survey was emailed directly to the presidents. The cover letter detailed the purposes of the survey, which were to: 1) assess worksite health promotion programming currently being done in Mississippi community colleges, and 2) assess community colleges' capability and resource capacity to deliver health promotion programs to employees. Presidents of the community college were asked to complete the survey or delegate the survey to a knowledgeable campus official. Follow-up emails were sent with the survey link along with a request for completion and return. The survey instrument consisted of 51 questions addressing employee demographic information, worksite wellness program offerings, management support for health promotion programs, and campus environmental support for worksite wellness programs. This study was approved by the Institutional Review Board at Mississippi State University. IRB-19-452

Results

Eight out of fifteen (53%) community colleges responded to the survey. Table 1 illustrates worksite wellness programs presently offered by the community colleges, and Table 2 provides specific institution size and enrollment data for the eight responding community colleges. While 87.5% of institutions reported having a wellness program for faculty and staff, fewer institutions (62%) supported structured fitness breaks or activities, and none supported such activities with flex time schedules or policies. Most (75%) institutions had wellness committees in place on their campus. Also, 100% of responding community colleges had cafeterias on campus and a gym, fitness facility, or workout room.

Health program topics (n=16) were identified and respondents were asked if programming occurred in these areas from the community colleges. Most commonly offered programs included physical activity (100%), nutrition (87.5%), and stress management (75%). The state of Mississippi leads the nation in obesity, yet only (75%) of institutions offered weight management programs. Mississippi also has disproportionately high rates of stroke and diabetes, but only 62% of institutions offered stroke prevention and 50% pre-diabetes or diabetes State institutions of higher learning in Mississippi are covered by health insurance from a single provider that offers worksite health interventions and/or information on all topics listed above as part of employee health coverage.

Table 1

Characteristics of Mississippi Community Colleges

Characteristics of Colleges	Number or Percent Valid
Number of employees	
100-249	25%
250-750	50%
>750	25%
Public Institution	100%
*Full-time	74%
*Part-time	26%
* Male	53%
*Female	47%
Multiple Worksites/campus locations	100%
Covered by State Health Plan	100%

*Race/Ethnicity of employees	
White	72%
Black/African American	24%
Hispanic	1%
Other Race	3%
Rural (# of campuses)	6
Urban (# of campuses)	2
Have flex-time schedule or policy	0%
Fitness breaks allowed/or provided	62%
Have health/wellness committee	75%
Wellness-related website present	25%
Wellness program for faculty/staff	87.5%
Cafeteria available on campus	100%
Healthy food options labeled	62%
Gym, fitness facility, or workout room on campus	100%
Walking trail (indoor or outdoor) on campus	75%
Showers/changing facilities on campus	100%
Offered class, workshop, or event on topic in past 12 months	
Tobacco Use	37%
High Blood Pressure	62%
Physical Activity	100%
Weight Management	75%
Nutrition	87.5%
Heart Attack and Stroke	62%
Prediabetes and/or Diabetes	50%
Depression	50%

Stress Management	75%
Alcohol and other Substance Use	25%
Occupational Health and Safety	62%
Maternal health and Lactation support	25%
Cancer	37%

*Indicates not all responses were recorded due to invalid data

Selected measures of environmental support/capacity are reported in Table 3. Sidewalks were present on all campuses enabling walking or other physical activity- based programs outdoors. Health promoting supports for indoor activity such as signage promoting stair usage were not present on any of the campuses.

Table 2

Characteristics of Participating Mississippi Community Colleges

Community College Characteristic	Percent Valid
Institution Size	
Small	25%
Medium	50%
Large	25%
Student Enrollment Data	
1,000-2,999	37.5%
3,000-4,999	37.5%
5,000-9,999	12.5%
>10,000	12.5%

Table 3

Environmental Support Characteristics of Mississippi Community Colleges

Environmental Support	Percent Valid
Signage promoting stair use	0%
Sidewalks present to promote physical activity	100%
Smoking completely prohibited on campus	87.5%

Discussion

The purpose of this study was to conduct an initial assessment of the potential for worksite health programs at community colleges in Mississippi to improve employee health and function as economic drivers in rural communities. Most Mississippi community colleges have some sort of health program in place for employees. Further, state employees are provided health insurance coverage which includes information and/or intervention on multiple conditions that affect the health of Mississippi citizens. Opportunities exist to link community college employees to such resources within the structure of the community college system. All responding campuses reported having gym, cafeteria, and showering facilities, and most had environmental structures in place, such as walking trails, to support overall wellbeing. Potential exists to enhance worksite wellness programs in Mississippi community colleges and surrounding communities that may otherwise lack supportive resources. Proximity to a community college can result in significant advantages in terms of resource availability. Crookston and Hooks (2012) found that when state appropriations made up the main portion of revenues, community colleges made a significant and constructive contribution to employment growth in the local areas. Community colleges and their students invest more than $1 billion in their local economies on a yearly basis. This investment leads to a job multiplier of 3.0, which means that one community college job creates an additional two jobs in the state of Mississippi (National Strategic Planning & Analysis Research Center [NSPARC], 2020). Health promotion programs on these campuses, with potential availability to surrounding communities, offer the possibility to assist in improving the health of current employees of the community college system and future employees within and outside of the system.

Annually, community colleges in Mississippi directly and indirectly generate "more than $2.1 billion in wages and salaries, $3.9 billion in state GDP, and $277 million in state and local tax revenue" (NSPARC, 2020). Lastly, community colleges employ more than 8,100 people statewide and are typically among the top-five employers in their respective regions (NSPARC, 2020). This makes community colleges essential employers in many areas, which can be conducive to positive economic and health outcomes in communities.

Limitations

This study was limited by a low response rate. Due to this, we were unable to identify any significant differences between community colleges based on their sizes (e.g., small, medium, large). Further in-depth research can help researchers recognize any differences in worksite health promotion programs in Mississippi community colleges. The Mississippi community college system includes 15 institutions, a number consistent with the smaller population of this largely rural state. The response rate was likely affected by COVID-19 considerations since institutions were dealing with proximal and insufficiently understood epidemiological data.

Recommendations for Future Research

The current project assesses baseline capacities and potential for development of worksite health promotion programs in community colleges and concomitantly in surrounding communities. Future studies should examine the existing environmental and other supports that currently exist as well as identify useful resources for program development in these facilities.

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The Kettlebell Clean is a Whole-Body Exercise That Elicits Similar Relative Contributions From Lower Body, Upper Body, and Core Muscles

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ABSTRACT

The use of Kettlebells (KBs) is common in training facilities throughout America; however, there is not much empirical research regarding the muscle activation patterns of individual KB exercises in naive kettlebell users. **PURPOSE**: This study investigated the muscle activation of eight different muscles during a one-arm KB Clean exercise in lifters who had minimal experience with KBs. **METHODS**: Fourteen resistance-trained male subjects (mean ± SD age = 21.5 ± 2.03 years, height = 180.87 ± 3.76 cm, mass = 85.53 ± 8.11 kg, and body fat = 12.86 ± 3.32%) completed the clean using a self-selected 8-10 maximal repetition (RM) load. Trial sessions consisted of subjects performing five repetitions of the KB clean. Mean electromyography (EMG) was used to assess the muscle activation patterns of the anterior deltoid (AD), posterior deltoid (PD), biceps brachii (BB), contralateral external oblique (EO), lumbar erector spinae (ES), gluteus maximus (GM), vastus lateralis (VL), and biceps femoris (BF), during the combined concentric and eccentric phases of each repetition using surface electrodes. The raw EMG data were rectified, smoothed, and normalized as a percentage of a maximal voluntary contraction obtained through manual muscle testing. The independent variable was the average muscle activation of the eight muscles (AD, PD, BB, EO, ES, GM, VL, and BF) allowing relative contributions of the muscles to be compared. The mean activation levels of the eight muscles were analyzed using a one-way analysis of variance ($p \leq 0.05$). **RESULTS**: The results revealed no significant differences between the individual muscle contributions during the KB Clean ($F_{7,91}=1.995$; $p=0.064$). **CONCLUSIONS**: Our data est–ablishes that the KB Clean is indeed a whole-body exercise where the AD, PD, BB, EO, ES, GM, VL, and BF make similar relative contributions to the effort. **PRACTICAL APPLICATIONS**: The KB Clean may be an appropriate and time-efficient exercise for individuals who desire to activate multiple muscles in a balanced manner.

***Keywords**: electromyography, muscle activation, resistance training*

Introduction

Kettlebells (KBs) have become mainstream resistance training implements used by sport-athletes, tactical-athletes, and fitness enthusiasts in myriad conditioning environments (Cotter, 2013). Kettlebells may also play a role in rehabilitation and, thus, their use is also of interest to athletic trainers and physical therapists (Brumitt et al., 2010; Crawford, 2011; Girard & Hussain, 2015; Zebis et al., 2013). Kettlebell training may be used to challenge the neurological control and musculoskeletal motor mechanisms in innumerable ways to develop strength, power, and endurance (Eckert & Snarr, 2016; Girard & Hussain, 2015; Jakobsen et al., 2013; Lake & Lauder, 2012; Manocchia et al., 2013). The KB Clean is a very common compound explosive endeavor incorporating muscles from the upper extremity, core, and lower extremities (Cotter, 2013). Research performed using EMG has revealed that muscle contributions across the KB Swing, KB Clean, and KB Snatch vary and, therefore, the exercises, while similar, are not redundant (Lyons et al., 2017). It has also been reported that while the KB Swing is a whole-body exercise, the relative contributions of the muscles of the upper extremity, core, and lower extremity are not distributed equally; some muscles contribute more than others (Lyons et al., 2020).

This report focuses specifically on select muscles employed while performing the KB Clean exercise. Therefore, it is the purpose of this manuscript to report the relative contributions of 8 different muscles during the KB Clean using electromyography (EMG). Results from this investigation will promote a better understanding among kinesiology professionals regarding individual muscle challenges during this common KB lift.

Methods

Experimental Approach to the Problem

This study used a cross-sectional design in which subjects performed KB Cleans with a standard cast iron KB (Power Systems Inc., Knoxville, TN) during a single testing session. Muscle activation (EMG) of eight different muscles [anterior deltoid (AD), posterior deltoid (PD), biceps brachii (BB), contralateral external oblique (EO), lumbar erector spinae (ES), gluteus maximus (GM), vastus lateralis (VL), and biceps femoris (BF)] was recorded during the KB Clean using a submaximal load and each muscle was normalized using a maximal voluntary isometric contraction. Available KB weights ranged from 20-80lbs. in 5lb. increments.

Subjects

Fourteen male subjects (mean ± SD age = 21.5 ± 2.03 yrs., height = 180.87 ± 3.76 cm, mass = 85.53 ± 8.11 kg, and body fat = 12.86 ± 3.32%) were recruited from a university population forming a convenience sample. Prior to the study, subjects completed a health history questionnaire and signed a statement of informed consent. The exclusion criteria of the study included: (a) musculoskeletal problems, (b) cardiorespiratory ailments, (c) metabolic disorders, (d) blood disorders, (e) history of psychological disorders, (f) use of tobacco products, (g) consuming more than 10 alcoholic beverages per week, and (h) less than six months of continuous recreational training. Subjects reported that they had not engaged in any exercise for at least 48 hours prior to testing. Subjects affirmed that they were all experienced lifters and had been resistance training for at least 6 months prior to the study. Subjects rated themselves "novice" KB lifters indicating that they had little or no experience with KBs on a pre-screening survey. Thus, they were resistance trained, but KB naïve subjects. All experimental procedures were reviewed and approved by the Institutional Review Board prior to the initiation of the study. All subjects completed the protocol.

Procedures

Each subject reported to the laboratory on two separate occasions prior to the experimental trial. In the first session, subjects were familiarized with the KB Clean. Subjects were instructed regarding proper lifting technique, described in the exercise technique section, by an experienced KB instructor who is also a Certified Strength and Conditioning Specialist. Subjects were allowed ample time to practice, and they were provided corrective feedback, so that they felt comfortable with the lift. In the next session, technique was reviewed, practiced, and then an experimental weight was determined for the lift. Subjects were asked to determine a load that could be performed with the dominant hand with good technique for 8-10 repetitions. All subjects were right-handed. If subjects could not achieve 8 repetitions, then a lighter KB was selected. If the subject could perform more than 10 repetitions, then a heavier KB was selected. An 8-10 maximal repetition (RM) was employed in order to control relative intensities across subjects. Subjects were not allowed into the data collection phase of the experiment until they consistently displayed proper lifting technique. Subjects' experimental loads for the KB Clean averaged 47.8 ± 11.48 lbs.

During the third visit, before the experimental trial, each subject warmed up by light pedaling on a stationary bike for 10 minutes. Preparation followed the protocol outlined by Criswell (2010). The subject's skin was prepared by shaving, abrading, and cleaning with a cotton ball soaked in a 70% isopropyl alcohol solution. Eight separate bipolar surface (2.0 cm center-to-center) electrode (Noraxon Dual Electrodes, silver/silver chloride) arrangements were placed on the right side of the body over the muscle bellies of the (AD), (PD), (BB), (EO), (ES), (GM), (VL), and (BF) according to the recommendations of Cram (Criswell, 2010). The electrodes for the AD muscle were placed on the anterior aspect of the arm, 4 cm below the clavicle, and approximately parallel to the muscle fibers. The electrodes for the PD muscle were placed 2 cm inferior to the lateral border of the spine of the scapula, and angled at an oblique angle toward the arm so that they run parallel to the muscle fibers. The electrodes for the BB muscle were placed over the longitudinal axis 1/3 the distance from the fossa cubit to the acromion process, starting at the fossa cubit. Since all the subjects were right-handed, the EO electrodes were placed on the left side of the body, as the left EO was expected to be more active due to its stabilizing role in the frontal plane counterbalancing the weight in the right hand. The EO electrodes 50% between the ribs and the ASIS, immediately superior to the ASIS, and at an oblique angle to run parallel to the muscle fibers. The electrodes for the ES muscle were placed 3 cm lateral to the L3 spinous process. The electrodes for the GM muscle were placed 6 cm lateral to the gluteal fold, 50% between the sacral vertebrae and the trochanter, and obliquely angled toward the hip to run parallel to the muscle fibers. The electrodes for the VL muscle were placed over the lateral portion of the muscle approximately 33% of the distance between the superior, lateral border of the patella to the anterior superior iliac spine (ASIS), and angled to approximate the pennation of the muscle fibers. The electrodes for the BF muscle were placed on the lateral aspect of the thigh 67% of the distance between the trochanter and popliteal fossa, starting at the trochanter. The belly of the BF muscle was identified by muscle palpation while holding the subject leg at 90° and having subject flex against tester resistance. The reference electrode was placed over the lateral clavicle, approximately 2 cm from the sternoclavicular joint. Interelectrode impedance was kept below 2000 Ω by shaving the area and careful skin abrasion. The EMG signal was pre-amplified (gain 1000x) using a differential amplifier (MyoResearch XP, NORAXON EMG & Sensor Systems, Scottsdale, AZ, bandwidth 10 – 500 Hz).

Subjects then performed 3, 5-second trials of a maximal voluntary isometric contraction (MVIC) against manual resistance from the researcher for each of the 8 muscles. All MVIC trials were performed by the same researcher and were based on standard muscle-testing techniques (Kendall et al., 2005). With the subject seated, the AD was tested with the glenohumeral joint abducted to 70º with 20º of flexion and the humerus in slight external rotation. The researcher stabilized the posterior scapula with one hand and provided downward resistance to the middle portion of the humerus while the subject attempted to abduct the shoulder. The position for the PD was identical to the anterior deltoid, except the humerus was abducted to 70º with 20º of extension. For the BB, the subject was seated with the elbow flexed to 90º and the forearm supinated. With one hand the researcher stabilized the distal end of the posterior humerus at the epicondyles while the hand provided resistance to the anterior distal end of the forearm while the subject attempted to flex the elbow. The EO was tested with the subject supine on an examination table with the hands behind the head. The researcher stabilized the lower extremities while the subject flexed and rotated the trunk. In order to minimize the risk of injury, this position was held and no manual resistance was provided. For the ES, the subject was placed prone on an examination table with the hands behind the head. With the researcher stabilizing the lower extremities, the subject raised the trunk from the table and held the position. Due to the risk of injury, no manual resistance was applied. For the GM, the subject was positioned supine on an examination table. With the knee flexed to 90º and the hip extended off the surface of the table, the researcher stabilized the posterior, lateral aspect of the low back. The researcher's other hand provided resistance to the posterior thigh while the subject attempted to extend the hip. The VL was tested with the subject seated and the knee in full extension. The researcher used one hand to stabilize the upper leg and provided resistance with the other hand proximal to the subject's ankle. For the BF, the subject lay prone on an examination table with the knee flexed to 70º and the hip externally rotated to 20º. The researcher stabilized the lateral hip with one hand and resisted knee flexion by placing the other hand proximal to the ankle. A 60 second rest period between trials was administered to avoid muscle fatigue. After all of the MVIC trials were complete, a 5-minute rest period was provided prior to the experimental trials.

Next, subjects completed 5 separate repetitions of the Clean. A one-minute rest was provided between each repetition. The velocity of each repetition was self-paced. Completion of the exercise condition occurred when 5 successful repetitions were accomplished. EMG was recorded during each KB Clean.

Exercise Description

The Clean is a popular compound ballistic KB exercise involving the lower body, core, and upper body musculature (Cotter, 2016; Lyons et al., 2017), and it is supposed to be initiated with great force so that momentum may aid in achieving optimal height during the pull in order to facilitate the "flip" at the end of the pull phase as the lifter transitions into the catch. Thus, subjects were instructed to initially maintain a "chest out, butt out" position while looking straight ahead with the KB hanging straight down between their legs in order to place the spine in an anatomically auspicious position. The KB Clean was initiated with the KB in the right hand, which was the dominant hand for all subjects, and feet shoulder-width apart. They were instructed to take a breath, and initially hold it as they commenced the pull. They were instructed to exhale as they pulled. During the pull, they were to utilize their entire body by explosively extending their knees and hips as well as flexing their elbow and abducting their shoulder in order to effectuate vertical displacement of the KB. Subjects were provided with the verbal cue, accompanied by instructor demonstration, of how to "pull straight up like you are pulling on the cord to start a lawn mower," thereby keeping the KB very close to the body and driving the elbow skyward like a one-handed explosive vertical row. They were specifically instructed not to perform a reverse curl with the KB. Once the KB had achieved adequate upward momentum and height, the subjects were instructed that they must allow the KB to flip as the elbow and hand quickly reversed positions allowing the KB to fall to the posterior aspect of the forearm during the catch. They were provided with specific instruction regarding the proper position of the forearm and the need to flex the hips and knees in order to safely absorb the impact of the KB during the catch phase. They were then shown how to properly recover. Subjects were specifically told that they were "to initiate movement of the KB, and pull and then catch the KB with a coordinated whole-body movement." Intermuscular coordination is, therefore, critical for this lift.

Instrumentation

EMG data was collected using the Noraxon Telemyo 2400T system (Noraxon USA Inc., Scottsdale, AZ). The EMG signal was telemetered to a receiver that contained a differential amplifier with an input impedance of 10 MΩ and a common mode rejection ratio of 130 dB. An amplifier gain of 1000 was used, and the signal-to noise-ratio was less than 1 μV RMS of the baseline. The EMG signals were then filtered with a bandpass Butterworth filter at 15 Hz and 500 Hz. The receiver was interfaced with a Latitude C840 computer (Dell, Round Rock, TX). Disposable 4 x 2.2 self-adhesive Ag/AgCl electrodes were used for data collection. A sampling rate of 1000Hz was used for all testing. Noraxon Myovideo version 1.7 was used in conjunction with a DCR-TRV 140 digital 8 video camera (Sony Corp, Tokyo, Japan) to time match EMG data to each repetition of every KB lift. EMG files were then accessed and processed using Noraxon Myoresearch XP version 1.07.

Data Processing

Raw EMG data were full-wave rectified and smoothed using a moving window (50ms) with a linear algorithm. The middle 3 seconds of the MVICs were used for data analysis, allowing subjects 1 second to reach full muscle activation and eliminating the potential effects of fatigue during the last second. For each subject, the MEMG during the MVIC trials were averaged for each of the 8 muscles. EMG data for the 8 muscles were then averaged during the KB Clean. The MEMG activity for the 8 muscles from the KB Clean was normalized as a percentage of the MVIC (%MVIC). Data were exported to Excel (version 2010; Microsoft Corp, Redmond, WA) and imported to SPSS (version 20 for Windows; SPSS, Inc., Chicago, IL) for analysis.

Statistical Analyses

In order to determine the relative activation during the KB Clean, the mean activation levels of the eight muscles (AD, PD, BB, EO, ES, GM, VL, and BF) were analyzed using a one-way analysis of variance. The alpha level was set at $p \leq 0.05$, and pairwise comparisons with a Bonferroni correction were used in the event of statistical significance.

Results

The results of the statistical analysis revealed no significant differences between the mean relative individual muscle contributions during the KB Clean ($F_{7,91}=1.995$; $p=0.064$). The observed statistical power was 0.749. Table 1 provides descriptive data regarding individual muscle contributions during the KB Clean.

Table 1

Descriptive Statistics: KB Clean
N = 14

Muscle	Mean % MVIC	Standard Deviation
Anterior Deltoid	47.16	± 17.55
Posterior Deltoid	28.30	± 17.82
Biceps Brachii	41.90	± 21.68
External Oblique	23.36	± 10.06
Erector Spinae	51.01	± 18.42
Gluteus Maximus	39.63	± 49.11
Vastus Lateralis	40.90	± 36.14
Biceps Femoris	45.16	± 25.91

Discussion

The purpose of this investigation was to compare, utilizing EMG, the muscle activation of eight different muscles during the KB Clean exercise, and to specifically look at the relative contributions of each of these muscles. The results of this study confirm that the KB Clean does incorporate muscles from the upper and lower extremities as well as the muscles that stabilize the core. It was also determined that these muscles make similar relative contributions during the lift.

A longitudinal training study should be performed in order to investigate whether the activation patterns of the muscles would change as the subjects develop more efficient motor patterns with practice. It would also be interesting to investigate whether different lifting intensities such as 1-3RM compared with 8-10RM would impact muscle activation patterns. And since intermuscular coordination is so crucial for this performance, it would be an interesting study to look at muscle activation patterns when comparing KB Clean performance using the dominant and non-dominant hands since the exercise is typically performed with both hands and not just the dominant hand. Further research regarding this is warranted.

As with any study, this study has limitations. The subjects were not randomly selected, but they represented a convenience sample. There were only 14 subjects tested. A larger number of subjects would have been desirable. Also, subjects could not be tested at the same time and, thus, subjects were tested individually at separate times of the day and on different days of the week.

Conclusion

The results of this study reinforce the notion that the KB Clean is a whole-body exercise suitable for active warm-up and general conditioning. The results also reveal that the muscles of the upper and lower extremities and the muscles of the trunk contribute similar efforts during this coordinated upper and lower body effort, at least in KB naïve subjects. The KB Clean is an excellent exercise option for those looking to vary their training programs and for those who wish to experience a balanced whole-body neurological and musculoskeletal challenge.

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