# THE EFFECTS OF STANCE-WIDTH ON MUSCLE ACTIVATION AND NUMBER OF REPETITIONS COMPLETED DURING ROMANIAN DEADLIFT

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## ABSTRACT

The purpose of the study was to determine the effects of stance-width on muscle activation and number of repetitions completed during narrow, shoulder-width and wide stance during Romanian deadlift (RDL) exercise. Thirty recreationally active, resistance trained men, aged 19-23 years old were randomly recruited based on volunteerism as participants in this study. The participants were assigned to perform the RDL with narrow, shoulder-width and wide stances while carrying 80% of one repetition maximum loading. Muscle activation was measured using electromyography (EMG) method at the vastus lateralis, biceps femoris, gluteus maximus and multifidus muscles. The EMG data were reported in concentric and eccentric values. The participants were given three trials, and the number of repetitions and EMG of most successful set were taken to be analyzed. One way repeated measure Analysis of Variances (ANOVA) was conducted to determine and compare the muscle activation and number of repetitions between the three stances. Analysis of concentric phase showed significant main effects were found in the gluteus maximus, $F(2, 58) = 338.97$; $p = 0.000$, and erector spinae muscle, $F(2, 58) = 302.19$, $p = 0.000$. Similar to the concentric phase, analysis of eccentric phase showed significant main effects were found in the gluteus maximus activation, $F(2, 58) = 204.982$; $p = 0.000$, and erector spinae muscle, $F(2, 58) = 215.184$, $p = 0.000$. Analysis of number of repetitions that can be completed by the participants showed significant main effects, $F(2, 28) = 37.152$; $p = 0.000$. In conclusion, different stance-width used did affect muscle activation and performance during RDL exercise. As the implication of this study, as can be seen in the EMG and number of repetitions data, performing wide and shoulder width stance are recommended as these stances allowed participants to perform better, without putting more stress on the lower back.

# KESAN LEBAR BUKAAN KAKI TERHADAP AKTIVITI OTOT DAN BILANGAN ULANGAN YANG DILAKUKAN KETIKA *ROMANIAN DEADLIFT*

## ABSTRAK

Tujuan kajian ini adalah untuk mengenalpasti kesan bukaan kaki terhadap pengaktifan otot dan jumlah ulangan yang dapat dilakukan semasa bukaan kaki sempit, bukaan seluas bahu dan bukaan kaki luas semasa senaman Romanian Deadlift (RDL). Tiga puluh lelaki aktif dan terlatih dalam latihan bebanan, yang berumur lingkungan 19 hingga 23 tahun telah dipilih secara rawak atas dasar sukarela sebagai peserta dalam kajian ini. Para peserta diminta untuk melakukan RDL dengan bukaan sempit, bukaan seluas bahu dan bukaan kaki luas sambil mengangkat beban 80% daripada nilai satu ulangan maksimum. Pengaktifan otot telah diukur menggunakan kaedah *electromyography* (EMG) pada otot *vastus lateralis, biceps femoris, gluteus maximus* dan *multifidus.* Data EMG dilapor dalam nilai konsentrik dan esentrik. Peserta diberi tiga kali percubaan, dan jumlah ulangan dan EMG pada set terbaik diambil untuk dianalisis. *One way repeated measure Analysis of Variances* (ANOVA) dijalankan untuk membandingkan pengaktifan otot dan jumlah ulangan antara ketiga-tiga bukaan kaki. Analisis terhadap fasa konsentrik menunjukkan kesan signifikan yang ketara telah dijumpai pada otot *gluteus maximus* $F(2, 58) = 338.97$; $p = 0.000$, dan *erector spinae*, $F(2, 58) = 302.19$; $p = 0.000$. Sama seperti fasa konsentrik, analisis fasa esentrik menunjukkan kesan signifikan yang ketara telah dijumpai pada pengaktifan otot *gluteus maximus*, $F(2, 58) = 302.19$, $p = 0.000$, dan *erector spinae*, $F(2, 58) = 215.184$, $p = 0.000$. Analisis jumlah ulangan yang dilakukan menunjukkan kesan signifikan yang ketara, $F(2, 28) = 37.152$; $p = 0.000$. Kesimpulannya, penggunaan bukaan kaki yang berbeza memberi kesan kepada pengaktifan otot dan prestasi semasa senaman RDL. Sebagai implikasi kajian, seperti yang dilihat pada data EMG dan jumlah ulangan yang dilakukan, melakukan RDL dengan bukaan kaki luas dan bukaan seluas bahu adalah lebih dicadangkan, kerana bukaan kaki ini membolehkan peserta melakukan senaman dengan lebih baik tanpa meletakkan tekanan yang lebih pada bahagian *lower back.*

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| | |
|---|---|
| 1RM | One- repetition maximum |
| ACL | Anterior cruciate ligament |
| ANOVA | Analysis of variance |
| BF | Bicep femoris |
| BIA | Bioelectrical Impedance Analysis |
| C7 | 7$^{th}$ cervical bone |
| CDL | Conventional deadlift |
| EMG | Electromyography |
| ES | Erector spinae |
| GM | Gluteus maximus |
| L3 | 3$^{rd}$ Lumbar bone |
| L4 | 4$^{th}$ lumbar bone |
| LSD | Least Significant Difference |
| MVIC | Maximum isometric voluntary contraction |
| NSCA | The National Strength and Conditioning Association |
| PAP | Post-activation potential |
| PAR-Q | Physical Activity Readiness Questionnaire |
| ROM | Range of motion |
| S1 | 1$^{st}$ sacral bone |

| | |
|---|---|
| SD | Standard deviation |
| SLDL | Stiff-legged deadlift |
| SPSS | Statistical Package of Social Science |
| T12 | $12^{th}$ thoracic bone |
| UPSI | Universiti Pendidikan Sultan Idris |
| VL | Vastus lateralis |

# CHAPTER 1

# INTRODUCTION



## 1.1 Background of the Study

Resistance training is one variation of training that defined as the training that exerts force or resistance progressively. It was traditionally used for developing hypertrophy of muscle especially for those who involves in bodybuilding and power lifting competition (Korak, Green, & O'Neal, 2015; Kraemer & Ratamess, 2004). In order to gain muscle hypertrophy, the training should consist a moderate to heavy load with a moderate to high numbers of repetitions and performed in multiple set. However, coaches, powerlifters and bodybuilders need to really concern about the content of training program that they designed and used. Mainly, in order to design a resistance training program, coaches or practitioner need to analyze the goals of the training, target muscles, type of training,

volumes, exercise order, and level of performance (Kraemer & Ratames, 2000). The load and repetition plays an important role in muscle strength and hypertrophy. It is suggested to perform submaximal load in between 65-80% of 1RM (Baechle, Eale, & Wathen, 2008). It is also suggested the use of single set of resistance training with the frequency of two or three times per week to enhance the performance of health cellular (Ribeiro et al., 2018). In recent decades, resistance training not only beneficial for hypertrophy, but also can increase power, speed and muscular endurance even as a part of rehabilitation training (Fisher, Bruce-Low, & Smith, 2013). Other than that, resistance training helps to improve in health, quality of life and functional status (Hunter, McCarthy, & Bamman, 2004; Buchner et al., 2017).

The uses of resistance training is to develop strength hence can improve the factor of velocity during performance (Knuttgen & Kraemer, 1987). Strength and power are the main component in sports especially in athletic. Deadlift, bench press and squat are the three exercises routine of resistance training that commonly used by the powerlifter or even coaches in their training program. These exercise had a great impact on improving the strength and power which helps the athlete to improve their performance (Young, 2006). In order to have the resistance training benefits, the performers need to understand and able to control the variables in designing resistance training program such as the load used, number of sets and repetition need to be done and other factor that is needed (Borde, Hortobagyi, & Granacher, 2015; Ratames et al., 2009).

Deadlift is one of the common exercises that have been a routine in resistance training, a posterior closed-kinetic chain exercise that target on leg and lower back muscle. Deadlift also involving the lower extremity muscles such as quadriceps, hamstring, gluteus maximus and back muscle such as erector spinae (Farley, 1995). Despite of that, it also involved other parts of body such as trapezius and latissimus dorsi by isometric contraction as a stabilizer during performing deadlift exercise (Lee, Schultz, Timgren, Staelgraeve, & Miller, 2018). The movement of this exercise just mimicking the movement of picking a thing on the floor, however, it is not easy to master and need to be trained in order to perform it correctly. The National Strength and Conditioning Association (NSCA) describe deadlift as performed in squat position where the feet are flat on the floor with the barbell slightly in front of the shins.



In order to perform deadlift, there are few factors need to be considered such as the type of deadlift, equipment used (eg. barbell, dumbbell) and type of handgrip that suit to the goals and suitability of the lifters. Deadlift can be performed by using different handgrip either it is performed by using free weight or even a stack machine. Commonly there are three types of handgrip which are grip with the palm facing down with the knuckle up known as pronated, palm up and knuckle down known as supinated handgrip and alternated hand grip with one hand used either supinated or pronated hand grip. Other than that, deadlift also performed with weight belt as the powerlifters or bodybuilders lift up the heavier load as an alternative protect lower back when it is highly pressured.

Instead of conventional deadlift (CDL) there are a few variations of deadlift that have been practiced, for example sumo deadlift, single leg deadlift and hexagonal barbell deadlift, stiff-legged deadlift, and Romanian deadlift. The executions of sumo deadlift mainly differ from conventional deadlift in which the execution of deadlift was in wider stance width with the feet 45° turn outward while the positioned of hand was in between the feet. It has been widely used by the lifter as it transfer force from upper to lower extremities optimally on gluteus and hamstring muscles (Escamilla et.al., 2002; McGuigan & Wilson, 1996). During the sumo deadlift, the lifter used alternated or pronated or even hook handgrip with shoulder width distance. As the sumo deadlift can maximize the biomechanical aspect in individuals, it will help the lifter to increase the weight lifted.



Ono et.al. (2011) defined stiff legged deadlift (SLDL) as performed by positioned the feet in shoulder width by holding the load at knee level at the starting position. Then the performer needs to lower the load by flexing the hip until the position of the upper body is horizontal. However, during this phase the participant need to make sure that the knee is in unlock condition to reduce the risk of injury then, the lifter needs to lift the load back to the starting position to complete the movement of stiff legged deadlift.

Romanian deadlift is mainly used to develop lower back strength as the technique used has been shown to decrease lower back stress. While conventional deadlift is performed by mimicking of picking a load from the floor by bending down, Romanian deadlift is reverse to the conventional deadlift as the performer hold the load in standing

position and lowering the load until the lowest point of flexibility (Piper & Waller, 2001). Romanian deadlift motion is almost similar with stiff-legged deadlift, but this type of deadlift performed with the knee is slightly bent at 15° while lowering the load to floor until the limit is reached. The performer need to lower the load by maintain the load closed to body. This variation of deadlift mainly activate muscle on hamstrings and lower back more than conventional deadlift as it performed with knee slightly bending the legs at starting position (Fisher et al., 2013).

A study conducted by Sorensen and his colleagues (2011) on the kinematics and kinetic of trunk during lifting found that the stance-width does not generate any muscle activation when 10 kg load is used during lifting. But, the result from this study showed a significant effect on peak acceleration and range of motion in sagittal plan. Unfortunately, it is contrast as the performer did lift the load at 70% of 1 Repetition Maximum, electromyographic (EMG) shows a significant effect on the gluteus maximus when maximum stance width is used during back squat in another study (Paoli, Marcolin, & Petrone, 2009).

However, there was no specific studies that investigating the effect of different stance during deadlift, especially Romanian deadlift. Few studies have been conducted on the effect of stance width on muscle activation during the deadlift especially Romanian deadlift. Thus, this study was conducted to compare the different type of stances which are narrow, shoulder width and wide stance on muscle and numbers of repetition

completed on muscle activation among recreationally resistance trained participants during performing Romanian deadlift exercise.

## 1.2 Statement of problem

Having a proper technique will help the practitioners to target a specific muscle during training. Thus, when designing a training program, coach or practitioner need to know what is the best exercises that will help to develop strength or power on the specific muscle. It is well known that deadlift exercise activate lower body muscle especially hamstring muscles (Fauth et al., 2010). However, while performing deadlift or other variation of deadlift, a different width of stance may be used. In previous studies, stance width activate muscle differently when a different stance width was used during squat (Hu, Shan, Zhou, & Ning, 2014; McCaw & Melrose, 1999; Paoli et al., 2009). Therefore, by altering the stance width during Romanian deadlift may give further insight for researcher and conditioning professional's a better understanding and deeper insight on the effect of stance width on the muscle activation.

This study sought to determine the difference of muscle activation level when narrow; shoulder width and wide stance were used during Romanian deadlift. In order to draw the differences, heavier loads were used (80% of 1RM), since there was no difference on muscle activation the lighter load were used (Sorensen et.al. 2011). Peak and mean EMG reading were observed during Romanian deadlift exercise.

## 1.3 Purpose of the Study

The purpose of the study is to determine the effect of three different stances which are narrow, shoulder width and wide stance on the activation muscles on vastus lateralis, biceps femoris, gluteus maximus and erector spinae during performing Romanian deadlift. This study is identifying which muscle will have a greater muscle activation and numbers of repetition while performing Romanian deadlift with three different stances.

## 1.4 Objectives of the study

To answer the question that been arisen, the objectives of the study are carried out as the following:

i. To compare the concentric muscle activation level between narrow, shoulder width and wide stance during Romanian deadlift exercise among recreationally resistance trained participants.

ii. To compare the eccentric muscle activation level between narrow, shoulder width and wide stance during Romanian deadlift exercise among recreationally resistance trained participants.

iii. To compare the number of repetitions completed between narrow, shoulder width and wide stance during Romanian deadlift exercise among recreationally resistance trained participants.

## 1.5 Research Questions

The research questions that arise within this study were as follows:

i. Are there any differences of concentric muscle activation level between narrow, shoulder width and wide stance during Romanian deadlift exercise among recreationally resistance trained participants?



ii. Are there any differences of eccentric muscle activation level between narrow, shoulder width and wide stance during Romanian deadlift exercise among recreationally resistance trained participants?

iii. Are there any differences of number of repetitions completed between narrow, shoulder width and wide stance during Romanian deadlift exercise among recreationally resistance trained participants?

## 1.6 Significance of the Study

The biomechanical changes in stance during performing exercise did affect the outcome of the exercise. Study on biomechanical squat that performed with different stance did change the kinematic measurement especially on hip, ankle and knee moment (Escamilla et al., 2001). While it is fairly well-known anecdotally, no scientific research exists to back the claims of fitness professionals that different stance-width of Romanian deadlift works the muscle activation differently. It is also no scientific evidence that focus on volume or numbers of repetition that can be completed during performing Romanian deadlift with different stance width. With research backing these claims, the outcome of this study would help the practitioner or athletes to have a better understanding on the effect of stance width on muscle activation level especially on lower extremities muscle hence, they can improved their performance by targeting the specific muscle using different variation of stance width.

## 1.7 Limitations of the Study

There are several factors that exceed the limitation of the researcher to control. The limitation factors that were figured out by the researcher during study as the follows:

i. The participants recruited were recreationally male resistance trained from Universiti Pendidikan Sultan Idris (UPSI).

ii. Motivation is one the psychological factor that indirectly contributed within this study. The maximal effort of the participants were needed to complete the task given during the session could affect the outcome of the research since this study was conducted in four days including the familiarization and test session within 48 hours gap. Beside, in order to activate the muscles during the execution of Romanian deadlift exercise with different stance width, the maximal load of 80% of the participnts' 1 Repetition maximum was used. The participant need to lift up the load until they failed to perform the proper execution of Romanian deadlift exercise hence, the level of motivation to complete the task within this study was beyond the researcher's capability. Besides, the participants were asked to used the self-pace lift in order to make sure the proper execution of Romanian deadlift instead of prevent from feel burden during the session was conducted.

iii. The study assumed that the participants had performed the Romanian deadlift with 80% or their 1 Repetition Maximum repeatedly, until they failed to perform the Romanian deadlift with a proper execution. However, the competency of the coach or assistance on honesty during the testing is not within the capability of the researcher to control. This is because during the session, coach or assistant was required to observe and correcting the movement error during the familiarization and test session. Common mistake was highlited as lowering the bar beyond the limitation set by the researcher, the positioned of the back muscle not in lordotic curve and lock the knee while performing the Romanian deadlift exercise (Frounfelter, 2000).

iv. Testing environment could lead an increase of anxiety level of the participant. However, it is out of the researcher's capability to handle.

v. Since the load used was 80% of 1 Repetition Maximum, the participants were asked to perform Romanian deadlift exercise with sel-pace to make sure the participant able to lift the load with a proper execution hence, enhance the mucle to activate and reduce fatique. Thus the pace was not within the control.

## 1.8 Delimitations of the Study

This study was delimited as the following criteria during the investigation:



i. The inclusion criterion for the study was only recreationally resistance trained male participants who aged of 19-23 (22.20±1.13) years old from Universiti Pendidikan Sultan Idris (UPSI) was selected to be a part of this study.

ii. The weight range of the participants was between 67 to 74 kg (70.4±3.64) with the height range of 167 to 173 cm (170±3.31) was delimited.

iii. The participants abled to perform Romanian deadlift exercise with 1-Repetition Maximum of at least 1.5 times of their bodyweight was recruited for this study.

iv. The participants were free from any musculoskeletal injuries for the past year and during this study were conducted. The participants were excluded if they were injured.

v. To avoid any discrepancies of gender, only male participant were selected to involve in this study as male had a greater muscle composition compared to female.

vi. The number of repetition only counted when the participant performed the Romanian deadlift exercise with proper execution with pronated handgrip.

vii. The study was only measures on four muscles which are vastus lateralis, bicep femoris, gluteus maximus and erector spinae to identify the difference of muscle activation during performing Romanian deadlift at 80% of 1 Repetition Maximum.

viii. The data collection of the study was held at physical conditional laboratory at Universiti Pendidikan Sultan Idris.

ix. The instruments used in this study were in a good condition before the study started.

x. The load use was submaximal load with 80% of 1 Repetition Maximum. This value was an optimal value to trigger the muscle activation level.

## 1.9 Operational Definitions

Those are definition the term that had been used and observed within this study:

i. Bicep femoris: Bicep femoris is one muscle of hamstring group instead of semitendinosus and semi membranosus muscle. The major action of bicep femoris are extension of thigh and flexion of knee (Marieb & Hoehn, 2010).

ii. Electromyography: Electromyography (EMG) is electrical recording equipment that measure muscle activity level that has been used within this study. The EMG reading in this study will be presented in peak and mean value during concentric and eccentric phase while performing the Romanian deadlift exercise with shoulder width, narrow and wide stance width (Wright, Delong, & Gehlsen, 1999).

iii. Erector spinae: Erector spinae is a back muscle that comprise of iliocostalis, longissimus and spinalis muscles. Erector spinae is a muscle that primarily move the back extension (Marieb & Hoehn, 2010).

iv. Gluteus maximus: Gluteus maximus is the largest gluteus muscles located superficially. Gluteus maximus act as a major thigh extensor (Marieb & Hoehn, 2010). Instead of gluteus maximus, glutes muscel also comprise of gluteus medius and gluteus minimus.

v. Narrow stance width: There are many measurements that represent narrows stance. However, this study define narrow stance width as the position of feet

is closed to each other during the performing Romanian deadlift exercise (Sorensen et al., 2011).

vi. 1 Repetition Maximum: One-Repetition maximum protocol was defined as the heaviest load that can be lifted by the performer in only one repetition of exercise with the proper execution (Clayton et al., 2015). It is an appropriate method to determine the resistance used in training (Baker, 2016). The procedure to measure 1 Repetition Maximum was by adding the load gradually when the performer can lift the load of the exercise repeatedly until they can only perform the exercise with one repetition with the proper execution. 1 Repetition Maximum is used as the guideline to determine the intensity or load used in training to trigger the muscle activation (Ruf, Chery, & Taylor, 2018). Thus, 80% of 1 Repetition Maximum Romanian deadlift was used to determine the muscle activation during this study. Romanian deadlift: One-Repetition maximum protocol was defined as the heaviest load that can be lifted by the performer in only one repetition of exercise with the proper execution (Clayton et al., 2015). It is an appropriate method to determine the resistance used in training (Baker, 2016). The procedure to measure 1 Repetition Maximum was by adding the load gradually when the performer can lift the load of the exercise repeatedly until they can only perform the exercise with one repetition with the proper execution. 1 Repetition Maximum is used as the guideline to determine the intensity or load used in training to trigger the muscle activation (Ruf, Chery, & Taylor, 2018). Thus, 80% of 1

Repetition Maximum Romanian deadlift was used to determine the muscle activation during this study.

vii. Recreationally resistance trained: The participant who involved in this investigation was recreationally resistance trained which defined as any person who involving the resistance training at least twice in a week (Khamoui et al., 2009). This study comprised of male participants aged 19 to 23 years old from Universiti Pendidikan Sultan Idris (UPSI) who had experience in deadlift training.

viii. Stance width: Stance width muscle was defined as the distance of feet in standing position during performing Romanian deadlift exercise in linear position (Rafael F Escamilla et al., n.d.; Paoli et al., 2009). This study varied the stance width by shoulder width, narrow and wide stance width.It is characterized as having an intermittent sport modality in which bio-motor determinant actions are performed at a high intensity and short duration requiring high levels of strength, velocity, and power (Lopes et al., 2015).

ix. Shoulder width stance: Shoulder width stance was one of the independence variable within this study that was determined by the position of feet which aligned with the shoulder width during performing the Romanian deadlift exercise (Sorensen et al., 2011).

x. Wide stance width: Wide stance width is defined as the feet position is 150% from participant shoulder width during performing the Romanian deadlift exercise (Sorensen et al., 2011).

xi. Vastus lateralis: Vastus lateralis is one of the quadriceps group muscles (rectus femoris, vastus medialis, vastus lateralis, vastus intermedius) that have the largest head that function as a knee stabilizer and extensor during movement (Marieb & Hoehn, 2010).

## 1.10 Summary

Resistance training was commonly used by the practitioner to develop strength and muscle hypertrophy especially powerlifter (Kraemer & Ratamess, 2004). In order to develop muscle hypertrophy, the exercise must be executed in proper technique to target specific muscle by using the submaximal to maximal load were used. Out of many exercise applied in resistance training, deadlift is the most suitable exercise that can activate the lower extremities muscle especially hamstring muscles when comparing to other resistance training exercises (Fauth et al., 2010). In the aspect of technique execution of Romanian deadlift or deadlift in general, difference stances could give different effect on muscle activation even only few study had conducted on manipulation of stances during performing the exercise (Escamilla et al., 2002). Hence, the objective of the study was to determine the effect of difference stance used (narrow, shoulder width and wide stance) on muscle activation level and numbers of repetition completed during performing Romanian deadlift exercise among recreationally resistance trained participants.