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THE EFFECT OF THREE DIFFERENT RESISTANCE LEVELS OF RUBBER BAND DURING A WARM UP PROTOCOL ON VERTICAL JUMP PERFORMANCE

NURSYAIDATUL HAFIZA BINTI MADZLAN

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(MASTER BY MIXED MODE)

FACULTY OF SPORT SCIENCE AND COACHING
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THE EFFECT OF THREE DIFFERENT RESISTANCE LEVEL OF RUBBER BAND DURING A WARM UP PROTOCOL ON VERTICAL JUMP PERFORMANCE

ABSTRACT

The purpose of this study was to investigate the effect of three different resistance levels of using rubber bands during a warm up protocol on vertical jump performance. Quasi experimental design was used in this study. Seventeen recreationally active males aged between 20 to 25 years old were randomly selected. The participants underwent four sessions consisted of (a) familiarization warm up, (b) warm up with orange color rubber band (high level of resistance), (c) warm up with blue color rubber band (medium level of resistance) and (d) warm up with green color rubber band (lower level of resistance). At the end of every session, the participants performed the squat jump on the force plate. The data on force, power and height of jump were collected and analyzed. Repeated Measure One-way ANOVA was utilized for data analysis. The force result indicated that the mean force (N) obtained for blue rubber band (M = 1532; ±SD = 251) was higher than green (M = 1507; ±SD = 268) and orange rubber band (M = 1511; ±SD = 264). In term of power (W), the mean power achieved for orange rubber band (M = 3384; ±SD = 459) was higher than green (M = 3296; ±SD = 444) and blue rubber band (M = 3256; ±SD = 455). Next, height of jump (cm), the mean height of jump for blue (M = 37.86; ±SD = 4.87) was higher than green (M = 36.34; ±SD=5.59) and orange rubber band (M = 36.59; ±SD = 5.49). However, ANOVA result indicated no significant difference between the different colors (difficulty levels) of rubber bands used on force *[F(2,14) = 0.544; p>0.05]*. There were also no significant differences found between the levels of resistance on the power *[F(2,14) = 3.656; p>0.05]* and height of jump *[F(2,14) = 0.988; p>0.05]*. In conclusion, the data revealed that the highest power was recorded when the highest resistance was applied in warm up. But in term of force and jump height, moderate resistance will produce the optimal force and height jump. In implication, the moderate and high resistant rubber bands could be used to improve vertical jump performance.

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ABSTRAK

Tujuan kajian ini adalah untuk mengkaji kesan tiga tahap rintangan yang berbeza menggunakan gelang getah semasa protokol pemanasan terhadap prestasi lompatan menegak. Reka bentuk kuasi experimen telah digunakan dalam kajian ini. Tujuh belas lelaki yang aktif secara rekreasi berusia antara 20 hingga 25 tahun dipilih secara rawak. Peserta-peserta menjalani empat sesi yang terdiri daripada (a) penyesuaian pemanasan, (b) pemanasan badan dengan jalur getah warna oren (tahap rintangan tinggi), (c) pemanasan badan dengan jalur getah warna biru (tahap rintangan sederhana) dan (d) pemanasan badan dengan jalur getah warna hijau (tahap rintangan rendah). Pada akhir setiap sesi, para peserta melakukan *squat jump* pada *force plate*. Data daya, kuasa dan ketinggian lompatan dikumpulkan dan dianalisis. Pengukuran berulang sehala ANOVA digunakan untuk analisis data. Hasil daya menunjukkan bahawa daya purata (N) yang diperoleh untuk jalur getah biru (M = 1532; ± SD = 251) lebih tinggi daripada hijau (M = 1507; ± SD = 268) dan jalur getah oren (M = 1511; ± SD = 264). Dari segi kuasa (W), kuasa purata yang dicapai untuk jalur getah oren (M = 3384; ± SD = 459) lebih tinggi daripada hijau (M = 3296; ± SD = 444) dan jalur getah biru (M = 3256; ± SD = 455). Seterusnya, ketinggian lompatan (cm), purata ketinggian lompatan untuk biru (M = 37.86; ± SD = 4.87) lebih tinggi daripada hijau (M = 36.34; ± SD = 5.59) dan jalur getah oren (M = 36.59; ± SD = 5.49). Namun, hasil ANOVA menunjukkan tidak ada perbezaan yang signifikan antara warna yang berbeza (tahap kesukaran) jalur getah yang digunakan terhadap daya *[F(2,14) = 0.544; p>0.05]*. Tidak juga terdapat perbezaan yang signifikan antara tahap rintangan terhadap kuasa *[F(2,14) = 3.656; p>0.05]* dan ketinggian lompatan *[F(2,14) = 0.988; p>0.05]*. Kesimpulan, data menunjukkan bahawa kuasa tertinggi dicatatkan ketika rintangan tertinggi digunakan semasa pemanasan badan. Tetapi dari segi daya dan ketinggian lompatan, rintangan sederhana akan menghasilkan daya dan lompatan ketinggian yang optimum. Implikasinya, jalur getah rintangan sederhana dan tinggi boleh digunakan untuk meningkatkan prestasi lompatan menegak.
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LIST OF ABBREVIATIONS

CMJ	Counter movement Jump
DS	Dynamic Stretching
EMS	Electromyostimulation
PAP	Post-Activation Potentiation
PARQ	Physical Activity Readiness Questionnaire
RPE	Rating of Perceived Exertion
SJ	Squat Jump
SS	Static Stretching
UPSI	Sultan Idris Education University

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CHAPTER 1

INTRODUCTION

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1.1 Background of Study

Warm up is essential in preparing the sports activity. Warm up gives the benefits in temperature-related mechanisms, and also non-temperature-related mechanisms (Bishop, 2003). Traditionally, the warm up routines consist of submaximal of aerobic exercise, static stretching, and followed by sport-specific dynamics activity. Static stretching gives the benefits of increasing the range of motion in preparing physical activities or competition. However, the implementation of static stretching before the competition or physical activities impaired speed, power, and strength (Church, Wiggin, Moode & Crist, 2001; Behm, Bambury, Cahill & Power, 2004). Besides, the dynamic warm up which mimicking sports movements used in training or competition gives a positive effect on the performance. According to Cilli, Gelen, Yildiz, Saglam, & Camur (2014) dynamic warm-

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up is included load resistance exercises, plyometric movements, or maximum voluntary contractions (MVC). Dynamic warm up enables activated the nerve-muscle function which resulted to increase the performance. This phenomenon called post-activation potentiation (PAP) which muscular performance is accurately enhanced when preceded by maximal or near-maximal neuromuscular activation (Zois, Bishop, Ball, & Aughey, 2011).

Hence, to assist the dynamic warm-up process, one of the current trends is to combine it with an additional piece of equipment that may assist elicitation of PAP and improves performance such as squat racks (Gourgoulis, Aggeloussis, Kasimatis, & Mavromatis, 2003) leg machines (Zois et al., 2011) and weighted vest (Cilli et al., 2014; Faigenbaum et al., 2006). Even though it has been proven the effectiveness, the factor of accessibility and portability of this equipment made is not practical to be used before any sporting events, especially when travel and availability of weight room are questionable. Due to these limitations, equipment like resistance band started to be introduced. The resistance band is a greatly portable, feasible, inexpensive, and undersized device (Page, Behm, & Aboodarda, 2015). This tool has a related percentage of hardness based on the colors. Basically, the resistance band is a tool that has been used in rehabilitation and helps in improving the strength and power performance while there are several studies about warm up area.

The effectiveness of using the resistance band as warm up tool is scarce in the literature review. Thus, it is the purpose of this to investigate the effect of the resistance band at a different level as a warm-up tool prior to strength and power-based activity. More precisely, this present study aims to investigate the immediate effect of using rubber band

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from various levels of resistance as part of warm up on vertical jump kinetics performance, kinematics performance, and level of session's rate of perceived exertion (sRPE)

1.2 Statement of the Problem

The preparation to start any physical activity is an important part of any athletic event. Well prepared in warm up routine is essential due to activate muscle fiber and readiness the muscle performs the extensive activity. While warm-up has been generally accepted as essential for safety and optimum performance in sports and physical activities, methods and approaches to warm-up are still expanding. The dynamic warm-up has been known to be able to assist in power-based performance. The dynamic warm up with added tools or equipment also one of the varieties of warm up methods. However, its usage benefits are still questionable and in need of further investigations and evidence. Nevertheless, the use of the resistance band is quite popular due to the fact that it is more portable and accessible rather than the other equipment like squat racks, and leg machines.

The warm up with resistance band showed a positive effect on the acute jump power (Buttifant & Hrysomallis, 2015). But, its findings are not inclusive. This study has shown that warm up with resistance band enable to gives a positive effect on kinetic and kinematic performances. However, this study had used the highest resistance band in the warm up protocol. Thus, this study was not able to determine what different levels of the resistance band enable will do on performance. This is where this study fits in. The current study will provide more inclusive findings that cover several levels of resistance of the rubber band, as that is how rubber band was promoted and sell. Besides, there are still

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inconsistencies in the finding of the warm up protocol that may affect the kinetic and kinematics performance. Hence, the purpose of this study is to look into the acute effect of the rubber band as part of warm up tool on kinetic, kinematic, and sRPE among the recreationally active males.

1.3 Significant of Study

Warm up is a routine before the start of any activity. The effectiveness of warm up protocol is dependable on its ability to increase the body temperature and readiness of the muscle fiber for the upcoming activities. Hence, the current study investigated the acute effect of using rubber band during warm up protocol on vertical jump kinetic performance, kinematics performance and rate perceive exertion. The resistance band has advantages in terms of accessibility and portability. Thus, the outcomes of this study would provide the needed information on the effectiveness of rubber band as part of warm-up protocol, and which of its resistance level the most suitable for explosive like performance as depicted by the jump.

1.4 Purpose of the Study

To investigate acute responses of using three different levels of resistance of rubber band during warm up on vertical jump kinetics, kinematics performance, and session's rate of perceived exertion (sRPE).

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1.5 Objectives of the Study

Specifically, the objectives of the study are as below:

1.5.1 To determine kinetics output produced during a vertical jump performance after warm-up session's using three different levels of resistance of rubber band on young recreationally active male.

1.5.2 To determine kinematics output produced during a vertical jump performance after warm-up session's using three different levels of resistance of rubber band on young recreationally active male.

1.5.3 To determine the perception on the difficulty level of each rubber band used based on session's rate of perceived exertion (sRPE) among young recreationally active male participants.

1.5.4 To investigate the differences between each of the warm-up using the three different level of resistance of rubber band on kinetics and kinematics output of vertical jump performance.

1.5.5 To investigate the relationship between levels of sRPE rated by the participants with the level of kinetics output measured by the force plate during the vertical jump performance, after performing a rubber band based warm-up.

1.6 Research Questions

1.6.1 What is the kinetics output produced during a vertical jump performance after warm-up session's using three different levels of resistance of rubber band on the young recreationally active males?

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1.6.2 What is the kinematics output produced during a vertical jump performance after warm-up session's using three different levels of resistance of rubber band on the young recreationally active male?

1.6.3 What is the perception on the difficulty level of each rubber band used based on session's rate of perceived exertion (sRPE) among young recreationally active male participants?

1.6.4 Is there any significant difference between the different levels of resistance band use as a tool in warm up session on kinetics and kinematics output of vertical jump performance?

1.6.5 Is there a significant relationship between the levels of sRPE rated by the participants with the level of kinetics output measured by the force plate during the vertical jump performance, after performing a rubber band based warm-up?

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1.7 Limitation

The limitation of this study includes the possible withdrawal of the participants due to time constrain for participation. That was due to the timing of data collection which bound by the limitation of the duration of the study of the researcher. Environmental temperature also was the factor that may influence the outputs of the study but was not be able to control by the researcher for this study. However, the data collection process was done at the same time of the day for all participants to reduce the environmental-physiology effect. While the participants were advised on maintaining normal dietary intake, it was beyond the researcher's ability to control the actual food and beverage intake of participants, which might contribute towards faster recovery for certain participants.

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1.8 Delimitation

The age group involved was delimited to 20-25 years old male-only, with participant's characteristics already as stated in the methodology section. The participants that recruited were from the sports science student of Faculty of Sports Science & Coaching, Sultan Idris Education University. The result that obtained might only be valid for a similar brand or made of the rubber band as what was used in this study. The use of rubber band was delimited for the color of the blue, green, and orange which represented it respectively hardness. The warm up protocol that added the resistance band is stated in the methodology section. The procedure of squat jump without arm swing has been used as the vertical jump testing on the force plate to measure kinetics and kinematics output.

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1.9 Operational Terms

The operational definitions of this study which used as the keys terms in this study were:

1.9.1 Acute effect

The acute effect is the physiological immediate effect in human body after the physical performance (Buchner et al., 2017).

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1.9.2 Kinetic performance

Kinetic is referring to the force in the study of motion (Magill, 2011). In this study, the kinetic measures were the force, and power as measured by using the force plate.

1.9.3 Kinematic performance

Kinematic referring the descriptor of motion without concern for the cause of that motion (Magill, 2011). In this study, the kinematic output was focused on the height of the jump (distance) during the vertical jump.

1.9.4 Rating of Perceived Exertion (RPE)

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The sRPE is based on 10 points or scale originated from Borg Rating of Perceived Exertion (RPE) which used to measure the physical activity intensity level or simply state the perceived exertion of how hard the body feels when it is working by the participants (Day, Mcguigan, Brice, & Foster, 2004).

1.9.5 Resistance Level

The resistance level is the hardness level to stretch the rubber band which depended on the color of the rubber band. In this study, the selected colors of the rubber band were orange, blue, and green.

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1.9.6 Rubber Band

The rubber band is the resistance band in which the resistance level of the band depends on the color of the rubber band. The color of the rubber band is orange, blue, and green color. The orange band is the high level of hardness with the 4kg of resistance whilst the blue band is the medium resistance with 3kg. Then, the green band is the low resistance with 2kg.

1.9.7 Vertical Jump

The vertical jump is the upright jumping performance. In this study, the squat jump was performed as a vertical jump performance.

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1.9.8 Warm up

Warm up is the low-intensity activities or exercises performed by the individual at the beginning of the exercise protocol, aiming at increasing the body (physiologically) readiness to exercise. The effect that can be observed such as elevated in heart rate and body temperature.

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1.9.9 Recreational Active Males

The recreationally active males from sports science students of Faculty of Sports Science & Coaching whom ages from 20 to 25 participate in the study.

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CHAPTER 2

LITERATURE REVIEW

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2.1 Introduction

Studies on warm-up protocols have consistently been conducted from time to time by many researchers. While the positive effect of warm-up has been widely accepted, the types or modalities for warm-up keep evolving from year to year, prompting more studies to be conducted to assess and evaluate the actual effect. This chapter provides the summaries of related articles regarding the warm up area and the effect of the resistance band.

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2.2 The Related Theory for Warm-up

Warm up is a crucial component before starting any physical activity (Costa, Medeiros, & Fukuda, 2011) as well as the explosive muscular performance (Obbs, Tolusso, & Fedewa, 2019). The warm up is suggested before performing any physical activities as it helps to prepare the body to perform the aerobic or anaerobic performance.

Typically, warm up consists of three phases or levels which are the submaximal aerobic, static stretching, and followed by sport-specific dynamics activity (Bishop, 2003b). The warm up session aims to increase the internal body temperature and prepares the cardiovascular system activity (Thomas, 2000). The component of the static stretching has been shown the detrimental effect through the study on maximal lower extremity power and strength production (Craig, Judge, Wildeman, & Bellar, 2011). That proved in a study by Loughran, Glasgow, Bleakley, & Mcveigh (2017), showed that the static stretching impaired the sprint and jump performance of the footballer. Besides, the review by Shrier, (2004) on the 23 articles has concluded that static stretching gives negative effect on sports performance.

The study on sport-specific dynamic warm up showed its positive effects on sports that required maximal force and power output (Craig et al., 2011; Thomas, 2000). Simply state, explosive or strength-based activities such as throwing, jumping, bounding and many more similar to it will gain benefits from practicing dynamic warm-up prior to the event. This happened due to an effect known as post-activation potentiation (PAP). The PAP defined as improved neuromuscular state observed after high-intensity exercise where increases in muscle contraction force following maximal or near-maximal contraction.

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Besides, the dynamic warm up had reported in reducing of injury (Manoel, Hariss-love, Danoff, & Miller, 2008), and increased the core temperature (Bishop, 2003a).

2.3 Types of Warm up

Bishop (2003a) has divided the warm up into two categories which are the passive and active warm up. The passive warm up used the external instruments like heating pads, sauna, and diathermy due to increasing the body temperature or core temperature. Then, the seconds category is active warm up which involving exercise likes cycling, jogging, and calisthenics at low-intensity levels. The active warm up is likely to induce greater metabolic and cardiovascular changes than passive warm up (Bishop, 2003a).

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2.4 Warm up Protocol with Tools

Recently, a lot of warm up protocols available to ensure athletes get the optimum benefit from it. Researchers have come out with ideas of different types of warm up protocols based on the desired sporting performance. Hence, the warm up session incorporates with equipment which called the functional warm up also becomes one of the trending warm up routines. The additional of any type of tools in warm up sessions enables it to give more benefits and provide variety to the warm up sessions. The use of tools as part of warm up is also beneficial in stabilizing muscle groups in a specific region (Thomas, 2000). The addition of tools as well as the addition of weight and force may give the positive effect on the performance, such as by incorporated studies have electromyostimulation (Bílý &

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Cacek, 2014; Sotiropoulos et al., 2010), weight vest (Deneke, Debeliso, & Luke, 2017; Barnes, Hopkins, Mcguigan, & Kilding, 2015; Winton, Stewart, Lloyd, Agouris Ioannis, & Keogh, 2012; Faigenbaum et al., 2006) and leg machine (Zois et al., 2011) during warm up protocol.

The use of electromyostimulation (EMS) as a tool of warm up sessions has shown improvement in the performance. One of the studies that have investigated the effect of the neuromuscular activation of knee extensors on vertical jump by using the EMS is a study by Bílý & Cacek (2014). In this study, they have compared the warm up routine using EMS versus session's used dynamic stretching. Ten recreational active males consist of sports science students had voluntarily participated in this study. The participants underwent four sessions which were the warm up with and without the EMS and also the warm up with and without the dynamic stretching. The warm up with EMS started with 5 minutes pedaling on the stationary bike with the cadence of 70 bpm followed with the EMS application applied in sitting position. Seven big muscles selected and stimulated by EMS within two minutes. After the warm up session, the participants performed two types of vertical based exercises which were the squat jump and drop jump. The result revealed that the effect of EMS was superior compared to dynamic stretching. The positive effect was shown in the EMS on height of drop jump but there were no significant effects on the squat jump performance. Thus, it showed the EMS contributes a positive effect on the different structures of the movement.

Contrast findings by Bily et al. (2015) showed that no significant differences were found between the use of EMS and dynamic stretching on the countermovement jump. The conflicting findings of these studies may be due to confounding factors and internal and

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external threats of the study**.** The benefit of using the EMS inconsistencies may due to the direct impulses that stimulate the muscle to make the participants muscles tiredness to performing the physical activity. Besides EMS, other equipment that normally used in warm up sessions is the leg machine. The study of leg machines as part of warm up has shown a positive effect. The study by Zois et al (2011) investigated the effectiveness between the use of leg press machines, small-sided games, and traditional warm up routines. The amateur male soccer players aged ranges from 19 to 25 years were recruited in this study. The participants have undergone five sessions which consist of familiarization, one baseline sessions, leg press warm up, small-sided game warm up, and traditional warm up. Every end of warm up sessions, the participants have tested on countermovement jump, reactive agility, and 15×20m sprint. Thus, the result revealed that leg press warm up showed a positive effect on CMJ and reactive agility.

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Another equipment that also can be utilized in a warm-up protocol is the dumbbells. A study by Needham, Orse, & Egens (2009) had investigated the use of the dumbbell in warm up protocol. The purpose of this study was to examine the effect of warm up protocol using dumbbell on anaerobic performance among elite youth soccer players. Twenty participants from elite soccer players had participated in this study. Three different warm up protocols were conducted in nonconsecutive days in a randomized order. The three different warm up protocols were Static Stretching (SS), Dynamic Stretching (DS), and Dynamic Stretching followed by eight front squats with 20% of body mass (DSR). Every different warm up protocol consists of five minutes of low intensity jogging in the DSR protocol, with the participants used the dumbbell as the resistance while performing the squat. Every after three and six minutes of each warm up routine, the participants were measured in term of their countermovement jump, 10m and 20m of sprint performance.

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Needham et al. (2009) at the end reported that the height of jump for the DSR and DS showed better results rather than SS protocol at three and six minutes. The result of 10m and 20m sprints also showed that DSR and DS protocol showed better results rather than SS protocol at three and six minutes. However, the DSR showed the slightly better rather than DS protocol. Hence, the study using eight repetitions of the squat with a 20% load of body weight as intensive neuromuscular activation showed a positive effect in performance rather than dynamic stretching. However, the use of the dumbbell in the warm up protocol is impractical due to the implementation in the real warm up competition and scenario. Even though a dumbbell is a portable tool but the weight of the dumbbell is irrelevant to setting in the real warm up situation.

Besides, the study by Berning et al. (2010) investigated the effect of Functional Isometric (FI) squat on the Countermovement Vertical Jump (CMVJ). The participant that of this study can be considered as beginners with participant's criteria stated that they must have at least a year experience in the resistance training. This study applied FI in warm up protocol which used the modified squat rack bolted to the ground, used with a barbell and heavyweight. The result showed a significant increase in vertical jump performance when FI applied with a heavy load. This heavy load elicits the PAP phenomenon which affects the performance. The heavy equipment showed a positive effect but it impractical to use in the real warm up sessions. The equipment like a squat rack, barbell, and dumbbell is the heavy equipment which not suitable to apply to warm up in a certain sport.

According to Deneke et al. (2017) to induce PAP in the real warm up during competition or training was remained elusive. Thus, the practical and portable tools needed in the real warm up scenario. Even the positive effect was found in the study involved

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squat rack, dumbbell, and barbell, this equipment was not suitable to use in the real warm up scenario. Hence, the portable characteristic of the equipment was needed to ease setting the warm up protocol. Another tool that was used as part of warm up routine is the weighted vest. Several studies investigated the benefits of a weighted vest on warm up area. One of the studies by Barnes et al. (2015) investigated the effect of warm up with a weighted vest on running performance. This study used the weighted vest during the strides of the warm up protocol. This study had compared the acute effect of strides with a weighted vest and without the weighted vest on endurance performance, neuromuscular, and metabolic variables. Eleven of well-trained males distance runner who aged range between 25 to 34 years old recruited in this study. The warm up procedure in this study started with the 10 minutes of self-paced jog and followed by 5 minutes submaximal running. Then, the participants performed 6 × 10-s strides with a walk-back recovery in 60 seconds. The participant were wearing the weighted vest or without vest during the strides of short duration fast running. The weighted vest was equivalent to 20% of the participant body mass. Before proceed to test, ten minutes of the recovery time was given to prepare the test. The test included in this study was the jump test, submaximal running test, and an incremental test. This study revealed that the acute effect of the warm up added weighted vest during strides showed that improvement in peak running speed and running economy. Besides, the result of this study also illustrated a moderate increase in leg stiffness. Thus, the researchers suggest that the warm up protocol using the weighted vest enables to increase endurance performance in the well-trained runner as well as an elite athlete.

Besides, the study by Deneke et al. (2017) focused on the effectiveness of using the weighted vest as a warm up tool. This study examined the effect of weighted jump warm up on vertical jump in volleyball athletes. This comparison study of with and without the

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weighted vest in the warm up session. At the end the warm up session, the participants have performed two different conditions of vertical jump test. The condition of the vertical jump test was 2-hand standing block VJ (SBVJ) starting with hands in a defensive position, and 1-hand 3-step approach VJ (AVJ) with arm swing. The result from this study revealed there was no significant difference between the warm up with and without the weighted vest on SBVJ performances. However, the inclusion of a weighted vest on warm up sessions found a positive effect on AVJ performance. The different findings between these two conditions of vertical jump test may due to the force and ability of PAP effects.

Furthermore, another study that investigated the effectiveness of weighted vest by Chattong, Brown, Coburn, & Noffal (2010) also found contradictory results. Twenty recreational active participants were recruited in this study. The participant underwent five sessions with and without the weighted vest. In the first session, the participants were asked to perform the box jump without the weighted vest with five repetitions. Then, at the end of the session participants were asked to perform the vertical jump. In another four sessions, the participants were randomly assigned to perform the box jump with the different load of the weighted vest at the end. The load that was used in the weighted vest was 5%, 10%, 15%, and 20% of each subject's respective bodyweight. The result of the study revealed that there was no significant difference between the different loads of weighted vests on the vertical jump performance. Thus, this study found that the acute effect of using the weighted vest with the variety of loaded showed no significant difference in the result of the vertical jump performance.

Even though certain equipment showed a positive effect on the kinetic and kinematic performance but the heavy equipment status made it difficult to set in the real

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warm up routine. The study on functional isometric squat by Berning et al. (2010) had investigated the effectiveness of using a squat rack as warm up tool in which the squad rack consists of the weighted plate and the bar. The functional isometric squat was used as warm up protocol. The thirteen trained weightlifter men and eight untrained men recruited participated and underwent the two sessions. The first warm up session consists of five minutes of cycling in low intensity. Meanwhile, the second warm up session consists of five minutes of cycling with low intensity and then followed by a functional isometric squat with 150% of 1RM. At the end of the warm up sessions, the participants performed the countermovement jump test (CMJ). The result of this study indicated that the warm up added functional isometric squat with 150% of 1RM showed a positive effect on CMVJ in trained weight lifter men. Untrained men showed no significant effect on the warm up added functional isometric squat with 150% of 1RM on CMVJ. It can be concluded that the additional functional isometric to the warm up routine able to increase the acute performance and explosive power among recreational lifter. However, the functional isometric is a heavy-duty that consists of the squat rack, barbell, and weighted plate which impractical and elusive in the real scenario of warm up competition. The difficulty of setting equipment in the warm up situation makes it impractical to implement. Thus, the portable and practical equipment is needed to add in the warm up protocol. The portable equipment that easy to bring anywhere needed in warm up sessions. Even the previous studies had proved the benefit of certain tools added in warm up areas, the status of practical, accessibility, and portable was more relevant needed to set up the warm up routine. Thus, the resistance band is the ones of the warm up tools that had those criteria

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2.5 Resistance Band

The resistance band also called rubber band or elastic band. According to Page et al. (2015) the elastic bands, rubber bands, and tubing (surgical tubing, sport cords, and bungy cords) are all included and known as the elastic resistance band. This tool creates resistance by the elasticity of the band. The production of resistance is produced when the stretch of the resistance applied. The elasticity of the rubber band is dependable on the color of the band. The colors that represent the resistance of the band provide different resistance according to the brands of the resistance band. The different elasticity creates the different hardness of the rubber band.

Many studies investigated the effect and the benefit of the resistance band towards exercise and physical activity. The benefits of using the rubber band have been demonstrated in rehabilitation area (Hughes, Hurd, Jones, & Sprigle, 1999; Patterson, Jansen, Hogan, & Nassif, 2001) as well as it promoting the strength (L. L. Andersen et al., 2010; Karaganova, 2016) and flexibility (Patterson et al., 2001). Besides, the resistance band also used among the older population which enables help in improving the physical function as well as mobility (Rogers, Sherwood, Rogers, & Bohlken, 2002; Yasuda et al., 2015).

This portable tool is popular among rehabilitators because it is easy to implement anywhere in the training program. Furthermore, this rubber band is a more user-friendly tool for any exercise or physical activity. This device also eases to implementation for any population such as young and older adult populations. As it practical to implement, this device is popular for all populations. Besides, the safety element provided this device made

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it easy to conduct and performing any physical activity. Other than that, it is a low-cost device and ease of maintenance training device. As mentioned by Yasuda et al., (2015) the resistance band is a portable device with low cost which ease to perform physical activity when comparing to the machines and free weight tool. It supported by Hughes et al. (1999) which mentioned that resistance is a low-cost device that enables bring anywhere to performing the activity. Thus, this study used the resistance band during the warm up routine to look at the immediate effect on physical performance.

2.6 Related Articles about Resistance Band

The resistance bands are not only familiar among the rehabilitator but also for coaches and trainers which used it as part of the training program. In the training program, the resistance band can be utilized as a single user and also the conjunction with other training tools. The study by Anderson, Sforzo, & Sigg (2008) investigated the effects of combining elastic and free weight resistance on strength and power in athletes. This study was compared the effect between the traditional training with the added resistance band and traditional barbell training alone. The result revealed that the strength is produced greater in the traditional training with added resistance band rather traditional barbell training alone. Besides, the result also showed that traditional training with added resistance bands gains more power in the lower body. According to Anderson et al. (2008) added a resistance band in the training program WAS enables to give a positive impact on kinetic and kinematic of the vertical jump performance. The study by Bellar et al. (2011) investigated the effectiveness of a combination of the resistance band and free weight on 1RM strength in the bench press. The finding of this study reported the addition of the resistance band on

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free weighted training showed a positive effect on strength performance due to the changes in the pattern of force production. Hence, this study suggested that the addition of the elastic band to the bench press be an effectiveness method to increase level of strength.

Besides, the effect of using the resistance band-aided in the training had investigated in a study by Argus, Gill, Keogh, Blazevish, & Hopkins (2011). The four weeks training program was investigated to compare the effect of assisting with the resistance band, resisted resistance, and free countermovement jump on vertical jump performance. The twenty-eight of the participant who aged from 21 to 27 years old had recruited in this study. The participants were divided into three groups which consist of assisted, resisted, and free countermovement jump. The assisted group must undergo the training countermovement jump with assisted the resistance band. The above of squat cage that the participants were performed the countermovement jump were attached to the hardness and the resistance band. Meanwhile, the resisted group was attached to the hardness and resistance band at the below of the squat cage. Then, the free countermovement jump group was performed the countermovement jump without the resistance band. The result of this study reported the assisted with the resistance band improved the peak force and the high of the jump. Hence, the result of the study illustrated that additional resistance bands in conditioning training enable increase vertical jump performances.

Besides, the result of the study supported the study by Cronin, Mcnair, & Marshall (2003) that investigated the effectiveness of using the additional resistance in ten weeks of the training program. The study recruited ten recreational males aged 22 to 26 years old. The result of this study has indicated that the additional resistance band with

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countermovement jump exercise has shown improvement in peak power, peak movement velocity, and jump height. Hence, the study supported the ability of the resistance band to enhancing the kinetic and kinematic performance.

Next, the study by Aboodarda, Yusof, Osman, Thompson, & Mokhtar (2013) examined the effect of an additional elastic force on kinetic and kinematic vertical jump performance. The fifteen trained males were recruited and undergone the three sessions of the training program. The three sessions consist of different conditions in performing the CMJ. The first session consists of the CMJ without a resistance band (FCMJ). The second session involved the addition of resistance band on CMJ which force applied 20% of participant's body mass (ACMJ-20). Then, third sessions involved the addition of a resistance band in which forces applied 30% of the participant's body mass (ACMJ-30). The participants performed three different conditions of CMJ with randomize order. The participant performed three trials of CMJ for each condition on the force plate. The results from this study indicated that groups with ACMJ-30 showed a better result compare with the other two groups. Thus, it showed that the force applied 30% of the participant's body mass showed a positive result on the force and power output.

Besides, the study by Galphin et al. (2015) which investigated the acute effect of the elastic bands on kinetic characteristic during the deadlift at moderate and high intensity showed the different outcomes. This study aimed to investigate the acute effect of the conjunction of the resistance band with free weight during the deadlift at the moderate and heavy load. Twelve resistance-trained men who aged range from 22 to 26 years old were selected to participate in this study. The participants underwent three sessions consisted of two variable resistance sessions (B1 and B2) and one free-weight session (NB). In the B1

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session, the participants completed 15% of the resistance band while the remaining 85% from the free weight at both intensities of 60 and 85% of 1RM. Then for the second session, the resistance for B2 came from 35% of the resistance band while 65% of the free weight resistance at both 60 and 85% of 1RM. The NB session is the traditional deadlift with an intensity of 60 and 85% of 1RM. all these sessions performed on the force plate to measure the kinetic outputs. The result of the study reported that 60% of the 1RM condition showed there were no significant differences between B1 and B2 on kinetic output. Thus, the additional resistance band with free weight (B1 and B2) at 85% of 1RM produced a greater peak and relative power output. The researchers of this study also mentioned that the addition of heavy resistance band during deadlift focused on speed and power but not for maximal force. Hence, the designing of training that focuses on speed or power must consider the use of the additional resistance band to exercises. Besides, the result of the study has supported by the study of Rhea et al. (2009) which investigated the effectiveness of using the resistance band as an additional load to the barbell on the physical performance. The resistance band used as an extra load on the barbell showed a positive effect rather than training barbell alone. This study showed a positive effect on strength and power performance.

The usage of the resistance bands in the training gave the benefit to the athlete because it enables to improve the performance. The resistance band used as a training tool for the variability of the training as well as reducing the boredom among the athlete towards the training routine. The selection of the various training that resulted in a positive impact is important to enhance the performance. Added the variety of tools in the training routine is one of the ways to enjoy performing the activities. However, the chronic effect that using the tool needs to investigate as the rubber band is one of the trending tools used

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for a training routine. Thus, the study by Joy, lowery, Souza, & Wilson (2016) investigated the effect of using the elastic band as a part of the component on the periodized resistance training. This research study has added the elastic bands in the training which to look at the chronic effect of the benefits of usage elastic band in the training program. The five weeks training program was conducted in which the participants were divided into two groups. Fourteen of the volleyball players with at least one year of experience in weightlifting program recruited to participate in this study. The participants were divided into two groups which are the Variable Resistance Training (VRT) and the free weights only (control group). The VRT group was applied the resistance band to the squat and bench press. At the end of the study, the researchers collected the result of the rate of power development (RPD), peak power, strength, body composition, and vertical jump height. Pre and post-test results were collected to measure the effectiveness of the training program. The post-test was collected after five weeks of the training program. The vertical jump test was collected using a force platform to measure power and RPD. The result of this study revealed that the VRT group showed better results rather the control group. It has shown that the result of power and strength have increased through the elastic bands are used in the training protocol. Hence, this suggested that the added resistance band in the training session enables an increase in athlete performance.

Next, the study by Shoepe, Ramirez, Rovetti, Kohler, & Almstedt (2011) examined the effect of 24 weeks of resistance training with simultaneous elastic and free weight loading on muscular performance among male and female college. The thirty-four recreationally active males and females aged from 18 to 33 years old were recruited in this study. The participants were divided into three groups which consisted of free weight only (6 males and 5 females), elastic band plus free weight group (5 males and 5 females), and

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controls group (5 males and 4 females). The free weight and elastic involved three days per week within 24 weeks to complete the training program. The training sessions consist of the whole body, periodized, high-intensity resistance (65-95% of one-repetition maximum) as the elastic band group added the elastic band. In week 24, the participants were tested the strength and power by used the isokinetic dynamometry and One-repetition maximums of squat and bench press. The result of the study revealed that there was no significant difference between the effect of the elastic band group and the free weight group on power performance. However, the researchers suggested the elastic band as an alternative method of training to develop the strength and power among females, novice and recreationally active college males. Hence, these results of the chronic effect of the study supported the result of the study by Joy et al. (2016). Therefore, the chronic study of the additional resistance band on the training program showed a positive impact on the kinetic and kinematic performance.

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Support by the study by Rhea, Kenn, & Dermody (2009) had investigated the effect of the conjunction of the resistance band with a free weight in 12 weeks training program. The additional resistance band on free weight showed positive effects on power and strength development. This study had examined the effectiveness of heavy and low movements and the variable resistance training (the conjunction of the rubber band with free weight) on power and strength development. The participants selected from a variety of sports such as baseball, track, football, and basketball. The result of this study mentioned that the addition of the rubber band on free weight in the variable resistance training showed the positive effects on peak power and peak force.

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However, there is some finding of the research shows the disadvantages of the resistance band. The finding of the research by Findley (2004) mentioned that physical activity with a rubber band was not suitable for resistance activity. This because of the muscle contraction and the production of the force was opposite to how the resistance band is working. Besides, Findley (2004) indicated that the resistance produced during the implementation of the rubber in sport-specific activity but it gave a negative effect on the range of motion and muscle growth. Thus, this study provided the negative side of the effectiveness of the resistance band due to muscle movement while performing the resistance in the physical activity.

Next, the study of the resistance band on perceived exertion loading. the study by Andersen et al. (2010) correlated the resistance level of the resistance band and the perceived rate exertion the sixteen female workers aged 30 to 40 years old volunteered to participate in this study. This study also measured the muscle activation on the five selected muscle during execution exercises with a resistance band. The activation muscles were looked into the trapezius, medial deltoid, splenius capitis, extensor digitorum communis, and infraspinatus muscles. The level of the resistance band was based on the color of the resistance band used. This study was used the red, green, blue, black, and silver colors of the rubber -band during the execution of the upper extremities exercise. The upper extremities exercises included the lateral raise, wrist extension, and shoulder external rotation with an additional resistance band. Then, after performing the exercises, the participants were asked the Borg CR10 scale. The Borg CR10 was used in this study for rated the hardness of resistance band during the performing the exercises. The study reported that there was a correlation between upper extremities exercise with the resistance band and the perceived rate exertion (Borg CR10 scale) Thus, this result indicated rate

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perceived exertion (RPE) scale was reliable and helpful tool for assessing the intensity of the exercise.

Besides, the results supported by the study of Day, Mcguigan, Brice, & Foster (2004) which investigated the reliability of the using the session rated perceived exertion (sRPE) scale in measuring in different level of intensity in training exercises. Hence, the result reported that the sRPE was a reliable tool in quantifying the different levels of intensity (high-intensity, moderate-intensity, and low intensity) of resistance training. Therefore, using the sRPE in evaluating the intensity of the resistance band was reliable as supported by the study of Andersen et al. (2010) and Day et al. (2004).

In the nutshell, the resistance bands that using in the training or the physical activity able to produce a positive effect on the kinetic and kinematic performance of the jumping. the study by Aboodarda et al. (2013) proved the positive effect founds on the height of the jump, force, and power output. Supported by the study of Anderson et al. (2008) founds a positive effect on the power output of the vertical jump. Thus, the use of resistance bands in physical activity has shown beneficial in improving kinetic and kinematics performance. Resistance band that is using as a tool in physical activity showed inconsistent findings in improving the performance as well as the explosive power. There is numerous of study that investigated the effectiveness of additional resistance band in training program. However, the studies of the resistance band in the warm up area are limited.

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2.7 Warm up with Resistance Band

The study by Buttifant and Hrysomallis (2015) used the resistance band as a warm up tool. This study had investigated the effect of various practices warm up protocol on acute lower body power. This study was recruited twelve semiprofessional Australian Rules male footballers from ages range from 18 to 24 years old. The participants were undergone three sessions of warm up protocol. There was a randomized to perform any of three sessions on the specific warm up protocol. Three specific warm up protocols consisted of the resistance band with box squat, barbell box squat, and a series of static stretching. The resistance level of the resistance band that used during warm up warm protocol was the highest resistance band. The result reported that the resistance band with box squat gave a positive effect on the vertical jump performance. This study also indicated that the moderate to the high intensity of warm up protocol with elastic resistance box squat influenced the power output. Hence, the findings of this study suggested the warm up with the elastic resistance band affected the kinetic performances. Thus, this portable device showed effectiveness in the warm up routine.

Even though the study by Buttifant and Hrysomallis (2015) has shown the improvement of the kinetic and kinematic performance but there is no study examine the effect of the different levels of resistance band on the performance. The elastic resistance band that consists of different levels of hardness should be investigated to distinguish the different levels of the effectiveness of the resistance band to enhance the performance.

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2.8 Summary

Several studies investigated the effectiveness of using an elastic band on physical activity such as the conjunction of the resistance band with free weight. There is also some study that investigated the production of kinetic and kinematic on additional resistance band during the vertical jump. The studies showed the resistance band-aided during vertical jump produced the greater power output and velocity rather than free vertical jump. Supported by the study of Baxter (2014), which reported that the resistance band enables to increase the force, velocity, and power compared to traditional free weight movements. Moreover, the additional resistance band on training program has shown the effectiveness in the moderate and long term training program (Argus et al., 2011; Cronin et al., 2003; Joy et al., 2016; Rhea et al., 2009). The study by Joy et al. (2016) investigated the effect of five weeks training program is the shortest period of the intervention study whilst the study by Shoepe et al. (2011) investigated the 24 weeks of the intervention study was the longest period. However, these studies have suggested that the resistance band showed a positive effect. Thus, the studies on an acute, moderate, and chronic period of studies have shown a positive impact on the related study of the resistance band. Despite the numerous studies that focused on the effect of additional resistance band on the training program, studies investigating the effect of the rubber band as part of warm up are scarce in the literature review. As the strength and power are one of the crucial components in attributes the success in all sporting area, the preparation before starting the competition that enables enhancing these components is needed. Hence, the study on the effect of the resistance band on the warm up area is the one of techniques of warm up that need to explore its advantages.

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Table 2.1
Listed a Summary of Some of The related Studies

Authors, Year	**Topic**	**Method**	**Results**
Needham. et al., (2009)	The acute effect of different warm-up protocols on anaerobic performance in Elite youth soccer players	Purpose: comparing the acute effects of 3 warm-up protocol on anaerobic performance in elite youth soccer players. Method: experimental cross over design study. Each warm-up protocol started with a 5 minutes low-intensity jog followed by 10 minutes of static stretching (SS), dynamic stretching (DS), or dynamic stretching followed by 8 front squats + 20% body mass (DSR) The tests were performed at 3 minute and 6 minutes after warm up protocol. Test that was performed are countermovement jump, vertical jump and 10m and20m sprint.	Vertical jump: DSR showed the better result rather than SR at both 3 and 6 minutes test. Then, DSR showed the better result than SS at 3 and 6 minutes (p, 0.05). sprint performance: The result show DSR and DS compared with SS at 3 and 6 minutes following each warm-up protocol (p, 0.05). Conclusion: The dynamics warm up with inclusion resistance has shown the improvement when compare to dynamic warm up.
Zois et al., (2011)	High-intensity warm-ups elicit superior performance to a current soccer warm-up routine	Purpose: investigate the acute effects of traditional warm up protocol and two alternatives, high intensity, short-duration protocol (5 repetition maximum leg press and small-sided games). Method: Ten male soccer players participated in this study. The participants performed a team-sport, a leg press or small sided game. After performing the warm up session, the participants performed the countermovement jump, reactive agility and 15 x 20m. Then, there has physiological measures included core temperature, blood lactate concentration, heart rate, and rating of perceived exertion.	Counter-movement jump: The improvement after performing small sided game (6%, ES: 0.8 ± 0.8) and leg press warm up (2%, ES: 0.3 ±0.5), when compared to the baseline. Reactive agility: The improvement after performing small sided game (4%, ES: 0.8 ± 0.7) and leg press (5%, ES: 1.1 ±0.7), when compared to the baseline. 20m sprint: Mean 20-m sprint times during the intermittent exercise task improved following the leg-press warm-up, when compared with the small-sided game (9%, ES: 0.9 ± 0.3) and team-sport warm-ups (7%, ES: 0.6 ± 0.6). Conclusions: There are shown the positive acute effect of performing leg press and small sided game compared to a traditional warm up protocol.

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Table 2.1 (continued)

Authors, Year	Topic	Method	Results
Samson et al., (2012)	Effect of dynamic and static stretching within general and activity specific warm-up protocols	Purpose: Investigate the effect of static stretching and dynamics stretching protocol within general and activity specific warm-ups Method: Nine male and ten female subjects were recruited and followed the four sessions: • General aerobic warm-up with static stretching. • General aerobic warm up with dynamic stretching. • General and specific warm-up with static stretching. • General and specific warm-up with dynamic stretching. Ends of sessions, participants were tested: • movement time (kicking movement of leg over 0.5 m distance), • countermovement jump height • sit and reach flexibility • 6 repetitions of 20m sprints.	20m sprint: There is no significant different between dynamic and static stretch groups existed in the absence of the sport specific warm-up. Sit and reach flexibility: The static stretch condition increased sit and reach range of motion (ROM) by 2.8% more (p=0.0083) than the dynamic condition The result indicates that applying of static stretching within an activity specific warm-up affect the range of motion in order to enhancing sprint performance.
Bily & Cacek (2014)	Effect of the neuromuscular activation of knee Extensors on vertical jump by using electrostimulation	Purpose: investigate the effect of the neuromuscular activation of knee extensor on vertical jump by using electrostimulation (EMS). Method: Ten healthy male students were participated in this study. The participants undergone four sessions to complete consist of : • Warm up with EMS, • Warm up without EMS, • Warm up and dynamics stretching • Warm up without dynamics stretching. Ends of warm up session, participant tested the squat jump and drop jump.	Squat jump: The height of squat jump showed no improvement either applies or not apply the EMS. Drop jump: There are significant difference between applied EMS and dynamics stretching. Conclusion: Using EMS method as part of warm up had showed no significant effect on squat jump performance but positive effect on height of drop jump.

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Table 2.1 (continued)

Authors, Year	Topic	Method	Results
Cilli et al., (2014)	Acute effects of a resisted dynamic warm-up protocol on jumping performance	Purpose: investigate the kinematic and kinetic changes when resistance is applied in horizontal and vertical directions, produced by using different percentages of body weight, on countermovement jump and squat jump. Method: Consisted of the seven sessions of warm up protocol with the resistance corresponding to different percentages of their body weights (2%, 4%, 6%, 8%, and 10%). Every each session consists of pre and posttest on countermovement jump and squat jump. Then, the researcher used a video camera in determine the changes in hip and knee joint angles at end of eccentric phase of the jump.	Pre and posttest of jump movement reported no significant difference between the vertical ground reaction forces applied by athletes was observed ($p>0.05$). Conclusion: The result claims that the resistance of 6-10% body weight capable being apply in dynamic warm up which to improve the jump performance.

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CHAPTER 3

METHODOLOGY

3.1 Introduction

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This experimental study was designed to investigate the acute effect of using a rubber band as part of warm up tool on vertical jump kinetic performance, kinematic performance, and level of session's rate of perceived exertion (sRPE). A description of the participant, instrumentation, research protocol, testing protocol and procedure, conceptual framework, and statistical analysis are discussed in this chapter.

3.2 Research Design

This study was an experimental, cross-over design acute responses study with randomized order. This study investigated the acute effect of the different levels of resistance band as part of warm up tools on the vertical jump performance. The participants have undergone

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the four sessions to investigate the effect of warm up on kinetics and kinematics. This study has identified several variables to determine the effect of using a rubber band as part of warm up tool on kinetic, kinematic, and sRPE. The independent variable is listed as warm up with an orange resistance band (orange), warm up with a blue resistance band (blue), and warm up with a green resistance band (green). The dependent variables in this study are kinetic output (force and power), kinematic output (height of jump), and sRPE scale.

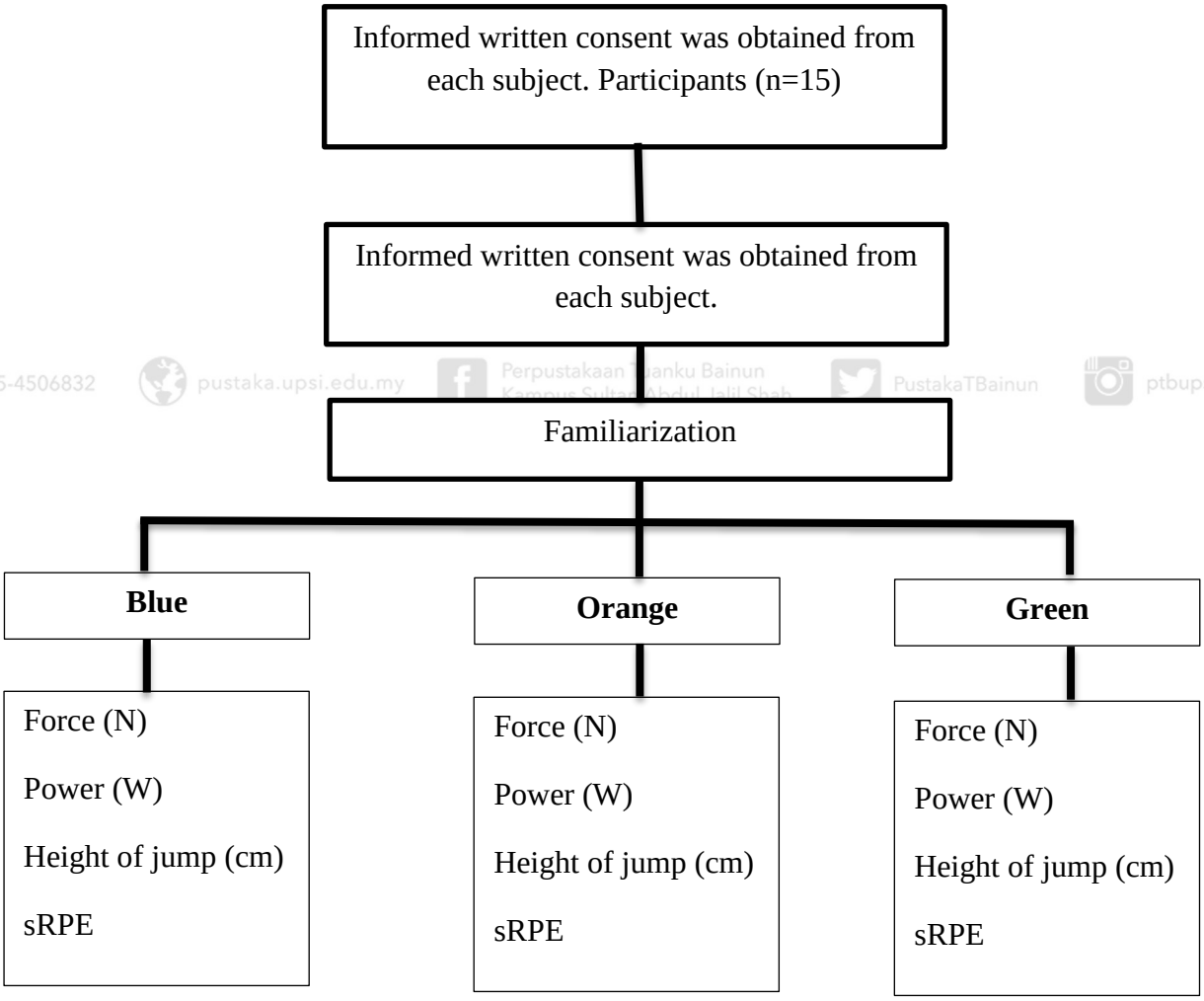


Figure 3.1. The data collection flow chat and study design procedure

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3.3 Conceptual Framework

The following was the conceptual framework that has been utilized in this study:

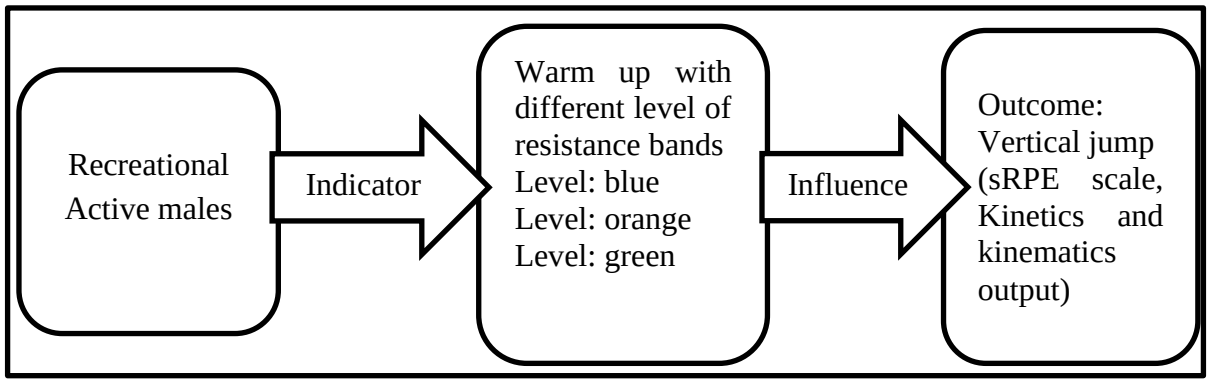


Figure 3.2. The conceptual framework of the research

3.4 Participant

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Seventeen recreationally active males age between 20 to 25 years old had participated in this study. The participants were sports science students from the Faculty of Sports Science & Coaching, Sultan Idris Education University. All participants were volunteered in nature; free withdrawers can be done at any time without the need for any given reason. A written consent form was explained and filled-up by the participants. The physical Readiness Questionnaire (PAR-Q; Thomas et al., 1992) as a screening tool was used to assess the level of physical fitness and the ability to participate in physical activity. The participants refrained from any food consumption and caffeine intake in the two hours prior to warm up sessions. The approval research process for work was sought after the Faculty of Sports Science & Coaching, Sultan Idris Education University approved.

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3.5 Instrumentation

The instrument that was used in warm up sessions were color-coded resistance band, heart rate monitor (Polar FT7, Polar Electro, Malaysia) RPE scale (McGuigan & Foster, 2004), and temperature monitor (Series, Company, Country of origin). Color-coded resistance rubber band (Gym in a Pocket, Fitness Concept, Shah Alam, Malaysia) was used as a warm-up tool. The color of the resistance band that was orange, blue and green was chosen based on the hardness. The orange band is the high level of hardness with the 4kg of resistance whilst the blue band is the medium resistance with 3kg. Then, the green band is the low resistance with 2kg.

Besides, the session's rate of perceived exertion (sRPE) was applied (McGuigan & Foster, 2004) to measure the intensity of the warm up sessions. This sRPE was used after performing the warm up with added the different levels of the resistance band. The validity and reliability of the sRPE were also confirmed in measuring the perceived exertion towards rehabilitation, physical activity, and also exercises testing (Day et al., 2004). Then, the heart rate monitor was to measure the heart rate on the warm up sessions. Then, the temperature monitor was used to monitor the temperature in the laboratory.

Besides, the instrument used in testing protocol was force plate, video camera, stationary tripod, and reflective marker. Vertical jump performance was performed on the top of the force platform (BP400600, AMTI, Watertown, and USA) to measure the peak force and power. Kinematics performance was measured using a video camera and analyzed using motion analysis software (0.8.15, Kinovea, France). Besides, the stationary tripod also used placed the video camera.

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3.6 Research Procedures

Participants were asked to attend r four different sessions, with a gap of at least 48 to 72 hours in between sessions. The first session was the briefing and familiarization session. The other three sessions were the testing sessions using either one of the resistance load of the rubber band. There were randomized in choosing the color of the rubber band.

In every session, the participants had performed the lower body warm-up session with the rubber band and at the end of the session, the participants were performed the squat jump. Before starting the warm up sessions, the participants wore the monitor heart rate at the chest. The resting HR of the participant was monitored and adjusted at 60 -70 bpm. Thus, the researcher was sure the participant in the resting heart rate which 60 - 70bpm. If the participant's heart rate was higher, they rest until their resting heart rate reaches 60-70bpm before start the warm up session.

The warm up session was taken about five to ten minutes with moderate intensity (Bishop, 2003c). Each session was started with a squat with a rubber band, single leg with a rubber band (right), single-leg with a rubber band (left) and calf raise with a rubber band. The intensity was monitored by the researcher was a heart rate monitor. If it was achieved the fifty percent of maximum heart rate after five minutes, the participants were asked to stop the warm up. If the participant’s heart rate were reached fifty percent of maximum heart rate before five minutes of warm up, the participants were asked to maintain the intensity until five minutes. Ends of warm up sessions, the participants were asked the level of RPE. The scale of RPE was the number one to ten and it was recorded as the level of

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RPE (McGuigan & Foster, 2004). Then, the participants were performed the squat jump at the force plate. The participants wore compression pants.

The squat jump test was performed in three trials. In this test, the arm-swing was prohibited, which their hands were placed on the hips throughout the test. Firstly, to start the squat jump test the participant must ready standing in front of the force plate. The participants were followed by the researcher cue to stand on the force platform. After asked to stand on the force platform, the participant's weight will be collected in the force plate. Then, the participants were asked to ready in the starting position of the squat jump test. The starting position of the squat jump test was in the squat position with hands placed on the hip. The squat position was the knee at 90° degree and trunk in the flexion position. As the cued was commend, from the squat position, the participants were jumped vertically as height as possible while the arms swing is prohibited. Then, all data were collected.

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Figure 3.3. The starting position of a squat with the knee at 90° degree

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The performing of squat jumps without the arm swing was recorded to measure the kinematics variables. Only one video camera was set up to record the movement of the squat jump. Hence, the video camera was placed seven meters from the right side of the force plate and the camera fixed on 1.2-meter height of stationary tripod (Panoutsakopoulos, Papachatzis, & Kollias, 2014). All of the warm up sessions with the resistance band and squat jump tests were conducted by the same instructor.

As all the data were collected, the researcher was analyzed the data. The force plate was contributed to the force data while the height of jump data was collected by using the motion analysis software. The data power did not contribute in the force plate data analyses. Thus, the Sayers Equation was used to measure the power of the performance (Sayers et al., 1999).

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The sayers equation of peak power output or peak anaerobic power output (PAPw):

PAPw (Watts) = (6.7 x jump height (cm)) + (45.3 x body mass (kg)) – 2055

3.7 Statistical Analysis

Data were analyzed by the Statistical Package for the Social Sciences (SPSS) version 23.0. Normality test was performed on all data collected to determine homogeneity of data collected. The normality test was done using Shapiro-Wilk because the sample size was less than 50 participants. All data were normally distributed and parametric types of tests were used. Statistical analyses as below were performed to answer all research questions listed in this proposal:

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Research question 1: Descriptive analysis with mean ± SD.

Research question 2: Descriptive analysis with mean ± SD.

Research question 3: Descriptive analysis with mean ± SD.

Research question 4: Descriptive analysis with mean ± SD. One-way repeated measure ANOVA

Research question 5: Descriptive analysis with mean ± SD and Pearson correlation.

3.8 Summary

The design of this study used was cross over design with randomized order. The seventeen recreational active males from sports science students of the Faculty of Sports Science & Coaching, Sultan Idris Education University participated in this study underwent four occasions. They were randomized to perform the warm up with added the different levels of resistance band (green, blue, and orange). The effect of warm up with the different levels of resistance band was looked into kinetic (force and power) and kinematic (height of jump) on squat jump without arm swing test. In this chapter, the procedure of this study was well explained regarding the warm up procedure and vertical jump test procedure. All the data were analyzed by using SPSS version 23.0 and one way repeated measure analysis of variance was used to determine the effect of warm up with the different levels of the resistance band and kinetic and kinematic output on vertical jump performance with a level of significance was accepted at $p < 0.05$.

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CHAPTER 4

RESULT

4.1 Introduction

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This chapter presents the data analysis and the findings of the study of the immediate of using the different levels of the resistance band in the warm up area on the vertical jump performance. All collected data were analyzed by using the Statistical Package for Social Sciences (SPSS) version 23.0. Data on demographic, descriptive analysis kinetic and kinematic variables, RPE scales on warm up are provided in this chapter.

4.2 Homogeneity of Variance

The homogeneity of variance used Munchly' Test of sphericity which this testing whether the variance in scores is the same for each different of conditions. If the significant value

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for Mauchly's Test of sphericity is greater than 0.05, the data is not violated the assumption of homogeneity of variance. Then, the data is violated if showed the significant value is less than 0.05 for Mauchly's Test of sphericity.

Table 4.1

Homogeneity Variance Data

Parameter	**Mauchly's W**	**Approx. Chi-Square**	**Sig.**	**Epsilon[b]**		
				Greenhouse-geisser	**Huynh-Feldt**	**Lower-bound**
Force	.313	17.445	.000*	. 593	.613	.500
Power	.993	.105	.949	.993		
Height of jump	.784	3.647	.161	.822		

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** The variance is significant at the .05 level*

The table 4.1 showed the result of Munchly' Test of sphericity to check the homogeneity of variance for data collected. The significant value for Munchly' Test of sphericity was greater than 0.05, so it indicated that the data did not violate the assumption of homogeneity of variance, thus F-value will be taken from line sphericity assumed in the test of within-subject effects. In other cases, the data violated the assumption when the significant value was less than 0.05 for Munchly' Test of sphericity, the F-value that produces from SPSS should not be trusted. As the assumption of sphericity has been violated, there are needed to look into the value of epsilon (Ɛ). Hence, when the value of epsilon is more than 0.75, use Huynh-Feidt correction but of the value eplison is less than 0.75, use the Greenhouse-Geisser correction in the test of within-subject effects.

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Table 4.1 presented the value of force showed a significant value which is less than 0.05. Thus, it indicated that the data is violated the assumption of homogeneity of variance. As the result showed which Mauchly's test indicated that the assumption of sphericity had been violated, x (2) = 17.45, p = .000, therefore degrees of freedom were corrected using Greenhouse-Geisser estimates of sphericity (Ɛ = .60). Next, the power performance was showed that the Mauchly's test indicated that the assumption of sphericity had not been violated, x (2) = 105, p = .949. Thus, the significant value for Munchly' Test of sphericity on power was greater than 0.05, so it indicated that the data did not violate the assumption of homogeneity of variance. Lastly, for the value of the height of the jump, the Mauchly's test indicated that the assumption of sphericity had not been violated, x (2) = 3.647, p = .822. Hence, the result indicated that the assumption of sphericity has been met, as the p-value is more than .05 which that the data did not violate the assumption of homogeneity.

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4.3 Descriptive Analysis

Descriptive analysis has been run to describe the data had been collected during the data collection process. The demographic data and descriptive data had been collected. This analysis provided the data of mean and standard deviation for all variables.

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4.3.1 Demographic Data

Table 4.2

Demographic Characteristics of the Study Participant

Characteristics	**Mean ± SD**
Age (years)	23 ± 0.85
Height (cm)	168 ± 5.85
Weight (kg)	65.94 ± 10.72

Table 4.2 presented that the demographic characteristics of 17 recreationally active males that participated in the research. The mean age of the participants that participated in this study was 23 ±0.85 years. Then, the mean height of the participants is 168 ±5.85cm. Besides, the mean weight for the participants is showed 65.94 ±10.72 kg.

4.3.2 Descriptive Data of Variables

Descriptive analysis was analyzed to describe the data that had been collected during the data collection process. This analysis provided the data of mean and standard deviation for all indicators.

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Table 4.3

Descriptive Data of the variables

Parameter	Color of rubber band	Mean ±SD	Sig.
Force (N)	Blue	1532.03 ± 251.33	0.50
	Green	1507.25 ± 268.52	
	Orange	1511.66 ± 264.30	
Power (W)	Blue	3256.67 ± 455.00	0.07
	Green	3296.13 ± 444.44	
	Orange	3384.63 ± 459.67	
Height of jump (cm)	Blue	37.86 ± 4.87	
	Green	36.34 ± 5.59	0.39
	Orange	36.60 ± 5.50	
sRPE scale	Blue	5.47 ± .80	
	Green	3.59 ± 1.0	
	Orange	6.24 ± .56	

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Table 4.3 indicated that the descriptive statistics of force for 17 participants involved in this study. The warm up protocol with the blue color of resistance band shows the mean of force is 1532.03± 251.33 N. Then, the mean of force for the warm up protocol with the green color of resistance band show the result 1507.25 ±268.52 N. Lastly, the mean force for the orange color of resistance band is 1511.66 ±264.30 N. As the result of table 2 presented it showed that the mean value of force for warm up with the blue color of the rubber band is the highest value rather than the green and orange color of the rubber band. Thus, the lowest mean value of force is the orange color of the rubber band.

Next, table 4.3 presented the result of descriptive statistics for power on the squat jump performance. The mean power for the warm up with the blue color of resistance band

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is 3256.67 ±455 W. Then, for the green color of the resistance band is 3296.13 ±444.44 W. Lastly, the mean power for the orange color of the resistance band is 3384.63 SD ±459.67 W. The using of the orange rubber band as part of warm up tool was showed the highest power in the squat jump performance rather than the green and blue color of the rubber band. Then, the blue rubber band was showed the lowest mean power produced in performing the squat jump.

The table above also presented the descriptive statistic for the height jump of the 17 participants after performing the warm up protocol with different colors of the resistance band. The warm up with the blue color of the resistance band had shown the mean height of the jump is 37.86 ±4.87 cm. Besides, the mean of the height of jump for the green color resistance band is 36.34 ±5.59 cm. Lastly, the mean for the height of the jump for the orange color of the resistance band is 36.60 ±5.50 cm. Hence, the warm up with blue rubber band showed the highest of height jump in squat jump performances rather than the green and blue color of the rubber bands. The lowest height of jump performances where indicated in the orange rubber band.

The table above has shown the descriptive statistics of sRPE scale on warm up with the rubber bands. The warm up with the blue color of the rubber band was shown the 5.47 ±.80 of sRPE scale. This indicates that the RPE scale of warm up with the blue color of the rubber band is hard. Then, the sRPE scale for the warm up with the green color of rubber band was shown 3.59 ±.1.0. This result indicates that the sRPE scale of warm up with the green color of the rubber band is moderate. Lastly, the sRPE scale for the warm up with the orange color of rubber band resulted in 6.24 ± .56. The scale of sRPE on this rubber band indicates that the hard rate of warm up intensity.

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4.4 Inferential Analysis

Repeated measure one-way ANOVA and correlation analysis were used in this current study. The repeated measure one way ANOVA was used to measure the kinetic (force and power) and kinematic (height of jump).

4.4.1 Repeated Measure One-way ANOVA

This study was used repeated measure one-way ANOVA to compare mean score of kinetic output (force, power) and kinematic output (height of jump) on the different colors of resistance band as warm up tools.

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4.4.1.1 Result of One-way Repeated Measures on the Force.

Table 4.4

Test of Within-subjects Effects for Force

Source		**Sig.**
Force	Greenhouse-Geisser	.499

The significant considered at the .05 level

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Table 4.4 presented the result of one-way repeated measures on the force. One-way repeated-measures ANOVA was conducted to compare the mean scores on force performance of squat jump with warm-up added rubber bands (blue, green, and orange). The results show that there was no significant effect of which type of tests influence the fitness level, F (1.19, 32) = .544, p = .499, within-subjects effects partial eta squared=.03. This result suggests a small effect size.

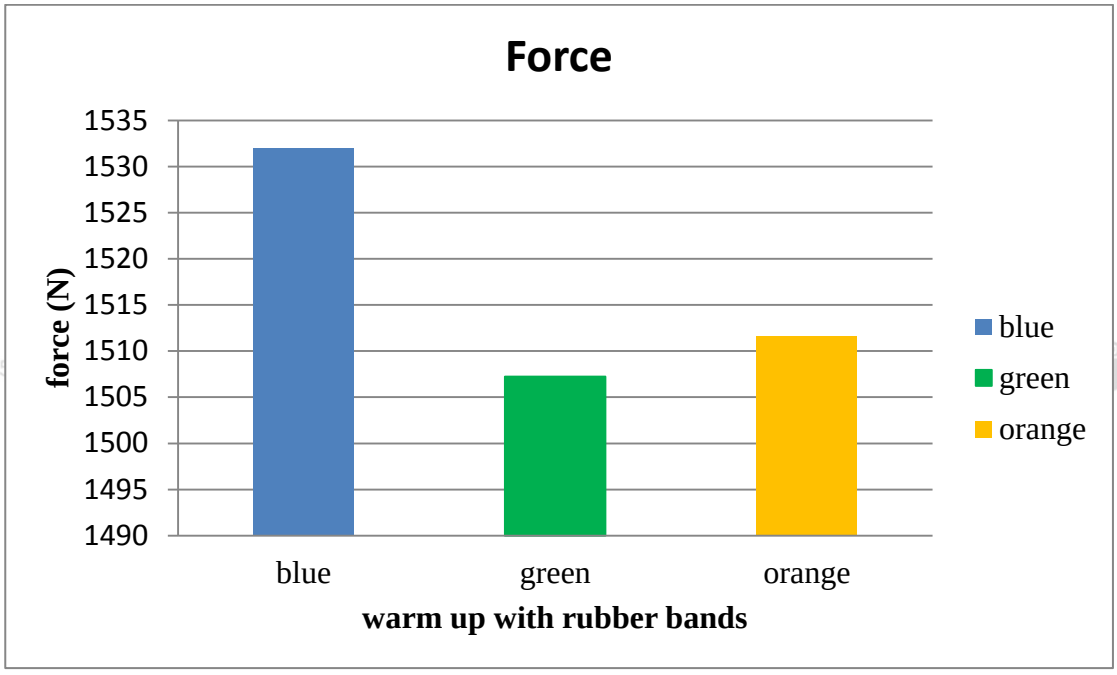


Figure 4.1. The bar graph of force on warm up with the different color of resistance band

Figure 4.1 illustrated that the result of force on squat jump performance after performing the warm up added with different colors of the rubber band. As the graph showed the result of force after performing the warm up with blue rubber bans was the highest force values rather than the other color of rubber bands. Then, the lowest force score can be seen in the result of the green color of the rubber band.

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4.4.1.2 Result of One-way Repeated Measures on Power.

Table 4.5

Test of Within-Subjects Effects on Power

Source		Sig.
Power	Sphericity Assumed	.07

The significant considered at the .05 level

A one-way repeated measures ANOVA was conducted to compare the scores on power performance of squat jump with warm-up added rubber bands (blue, green, and orange). Table 4.5 presented the result on the test of within-subject effects for power at squat jump performances. That results indicated that there was an insignificant effect of which type of tests influence the fitness level, F (2, 32) = 3.656, p = .07, within-subjects effects partial eta squared=.19. This result suggests a very large effect size.

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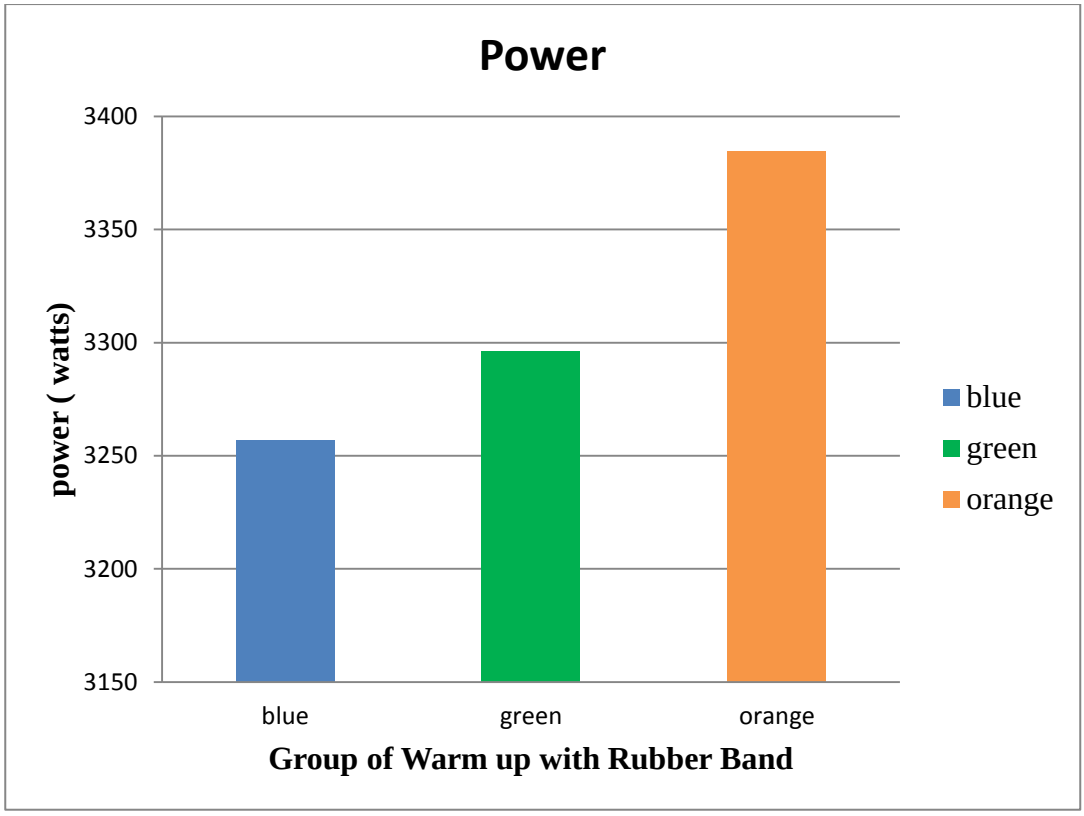


Figure 4.2. The bar graph of the warm up with the different color of resistance band and power (watts)

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4.4.1.3 Result of One-way Repeated Measures on Height of Jump.

Table 4.6

Test of Within-subjects Effects for the Height of the Jump

Source		Sig.
Height of jump	Greenhouse-Geisser	.383

The variance considered at the .05 level

A one-way repeated measures ANOVA was conducted to compare the scores on the power performance of squat jump with warm-up added rubber bands (blue, green, and orange). Table 4.6 presented the test of within-subject effects of height on squat jump performances. Thus, the results show that there was no significant effect of which type of tests influence the fitness level, F (2, 32) = .656, p = .0383, within-subjects effects partial eta squared=.06. This result suggests a moderate effect size.

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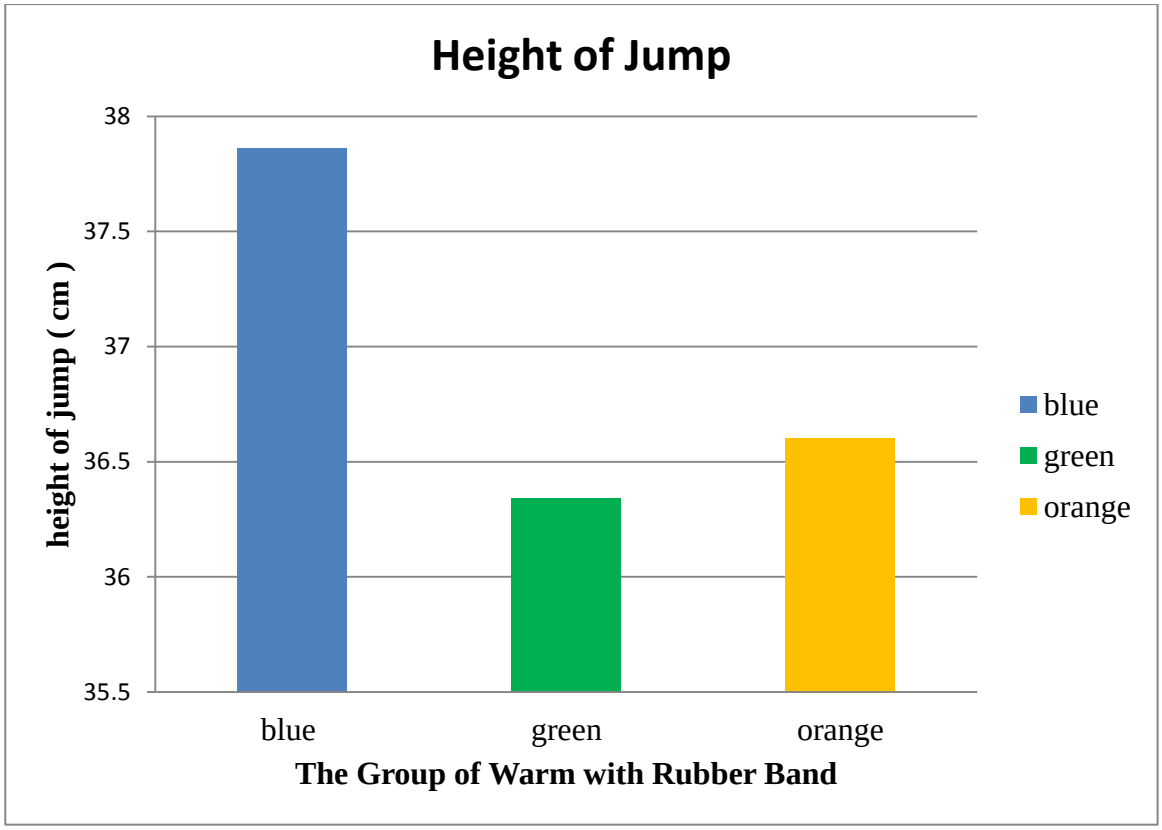


Figure 4.3. The bar graph of the warm up with the different color of resistance band and height of the vertical jump performance

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4.4.2 Correlation

The correlation analysis was used in this study to look into the relationship between the levels of sRPE rated by the participants after performing the different colors of rubber as warm up tools with the level of kinetics output (force and power) measured by force plate during the squat jump performance.

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Table 4.7

Pearson Product-moment Correlations between Measures of sRPE Scale on Warm Up with Different Colors of Rubber Bands and Kinetic Output (Force and Power)

Parameter	Force	Power
Blue	.429	.299
Green	.219	.290
Orange	.342	.197

r=1.00

The relationship between sRPE scale of blue, green, and orange color of the rubber band and the kinetic output of squat jump (force and power) was investigated using Pearson product-moment correlation coefficient. Preliminary analyses were performed to ensure no violation of the assumption of normality, linearity, and homoscedasticity.

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The relationship between sRPE scale of blue rubber band and force was investigated. There was a moderate, positive correlation between two variables, r=.429, n=17, p>.001, with a hard level of sRPE scale associated with a medium level of power of the squat jump. Then, the measuring of the relationship between sRPE scale of the blue color of the rubber band and power of squat jump resulted in a weak, positive correlation between two variables, r=.229, n=17,p>.001, with the hard level of sRPE scale associated with a lower level of power of squat jump.

Besides, the relationship between sRPE scale of green color of the rubber band and the level of force produced in squat jump was showed the weak, positive correlation between two variables, r=.219, n=17,p>.001, with a moderate level of sRPE scale

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associated with a lower level of power produced on the squat jump. Then the relationship between sRPE scale of green color of the rubber band and the level of power produced was showed the weak, positive correlation between two variables, r=.290, n=17,p>.001, with a moderate level of sRPE scale associated with a lower level of power produced on the squat jump.

Then, the relationship between sRPE scale of the orange color of the rubber band and the level of force produced in squat jump was showed the moderate, positive correlation between two variables, r=.342, n=17,p>.001, with the hard level of sRPE scale associated with a lower level of power produced on the squat jump. Then the relationship between sRPE scale of green color of the rubber band and the level of power produced was showed the weak, positive correlation between two variables, r=.197, n=17,p>.001, with the hard level of sRPE scale associated with a lower level of power produced on the squat jump.

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4.5 Summary of the Result

Table 4.8

The Summary of the Result

Research questions	**Conclusion**
What is the kinetics output produced during a vertical jump performance after warm-up sessions using three different levels of resistance of rubber band on the young recreationally active male?	The kinetics output that has been measured is force and power. **Force output:** The highest force output was the blue band 1532.03 ±251.33 N. Then, the orange band showed the second-highest of the force output with 1511.66 ±264.30 N. The lowest force output resulted in a green band with 1507.25 ±268.52 N. **Power output:** The highest result of power output was the orange band with 3384.63 ±459.67 W. The second highest was the green band showed 3296.13 ±444.44 W. The lowest power output was the blue band with 3256.67 ±455.00 W.

(Continued)

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Table 4.8 (continued)

Research questions	**Conclusion**
What is the kinematics output produced during a vertical jump performance after the warm-up session using three different levels of resistance of rubber band on the young recreationally active male?	The kinematic output that measured is the height of the jump. The result of the height of the squat jump showed that the blue band is the highest jump output which 37.86 ±4.87 cm then followed by an orange band with 36.60 ±5.50 cm. then the lowest height jump output is the green band with 36.34 ±5.59 cm.
What is the perception on the difficulty level of each rubber band used based on session's rate of perceived exertion (sRPE) among young recreationally active male participants?	The perception on the difficulty level of each rubber band used based on session's rate of perceived exertion (sRPE) was showed that the green band is the lowest level of the difficulty with the sRPE showed 3.59 ±1.0. In the result of the green sRPE scale showed that the difficulty of the band is moderate to somewhat hard scale. Then, the blue band showed the sRPE result of 5.47 ±.80. This blue band is a hard scale. Then followed by the orange band with the highest result of sRPE which 6.24 ±.56. In the sRPE scale indicate that the orange band is hard of difficulty.

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Table 4.8 (continued)

Research questions	**Conclusion**
Are there any significant differences between each of the warm-up using the three different level of resistance of rubber band on kinetics and kinematics output of vertical jump performance?	The force output: There were no significant differences found in the different levels of the resistance band (blue, green, and orange) on force output of vertical jump performance. The height of jump: There were no significant differences found in the different levels of the resistance band (blue, green, and orange) on the height of the jump output of vertical jump performance. The power output : There were no significant differences found in the different levels of the resistance band (blue, green, and orange) on the power output of vertical jump performance.
Is there a significant relationship between the levels of sRPE rated by the participants with the level of kinetics output measured by the force plate during the vertical jump performance, after performing warm-up?	The result revealed that there was no significant relationship between the levels of sRPE rated by the participants with a level of kinetics output measured by the force plate during the vertical jump performance, after performing warm-up.

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CHAPTER 5

DISCUSSION, CONCLUSION & RECOMMENDATION

5.1 Introduction

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The current study investigated the effect of the warm up protocol with resistance band on the kinetic and kinematic vertical jump performances among recreational active males at Sultan Idris Education University. Thus, this chapter provided discussions of the result in chapter four. The discussion will focus on the result of the force, power, height of the jump, and session rate perceived exertion (RPE). The conclusion and recommendation of future research also provided in this chapter.

5.2 Discussions

According to Buttifant & Hrysomallis (2015) the resistance band is an inexpensive and portable tool that can be applied everywhere as well as immediately before the

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commencement of the competition. Thus, the collected findings of this study may serve as a guideline for using the resistance band as a part warm up tool. Besides, these results also provided the alternate warm up tool in improving the kinetic and kinematic performances on vertical jump performance. Hence, the benefit of the current study on the warm up that added the resistance band can be served if the positive effect found in the current study. Unfortunately, the result of this study revealed that is no statistically significant difference between the kinetic and kinematic output of the vertical jump and the warm up added the different levels of resistance bands.

Overall to conclude the effect of warm up added the different levels of resistance bands on kinetic and kinematic performances may due to the protocol of training. This current study found an insignificant difference between the effects of the warm up added the different levels of resistance bands on the force production and the height of the jump. These two components are related to each other which the certain rates force production may affect the result of the height vertical jump. Thus, the optimal force development must be well prepared before the commencement of the performance.

The duration and intensity of the warm up is the crucial component that may affect the jumping performance. As suggested by Bishop (2003) the duration of warm up for the short performance is between five minutes to the ten minutes and the intensity should be in moderate intensity. According to a study by Mandengue et al. (2009) state that the athletes select their intensity is one of the best methods to produce the optimal result of warm up. The study by Mandengue et al. (2009) investigated the methodology approach optimal active warm up intensity. The study was used the prediction equation in the mathematical model to induce the optimal warm up to enhance the performance. The participants were

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commanded to select their warm up protocol called warm up field (FWU). The FWU is any limitation on the intensity and duration of warm up protocol. The result revealed the warm up routine that impacted the performance was from the range of 50% to 70% of power maximum that induces 80% of heart rate maximum.

Then, the study also indicated that warm up routine induced an oxygen consumption of from 65% to 75% of VO2max and blood lactate accumulation of 44.3 ± 18.6% (La−). The finding of the study stated that the self-selected warm up routine on duration, intensity, and mode able to enhancing the optimal performance. As a result of this study revealed, that can be concluded that this warm up study induced the PAP. Then, affecting the PAP enables induced of force production. Contrast with the finding of the current study that showed the negative effect on force and height of jump may due to the intensity of the warm up. The current study was using 60% percent of the HRmax for the warm up intensity by suggestion Bishop (2003). According to Bishop (2003), the short performance needs adequate intensity due to increasing the body temperature but not impair the availability of the high energy phosphate before real performances. The research has suggested that 40% to 70% of maximal oxygen consumption with duration five minutes to ten minutes is adequate to improve short performance as well as immediate performance.

As mentioned by Bishop (2003), the intensity of this study able induced the performances but the result of this current study showed insignificant results of force production and height of the jump. The result showed insignificant in three colors of resistance bands that added during warm up may be due to the level of resistance band produce the same force and cannot diverse the height jump. Then, the current study does

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not investigate the effect between pre and post of the warm up creates difficulty to deny the ability of the intensity of the warm up.

On the other hand, the result of this current study found the contrast result from the study by Buttifant & Hrysomallis (2015). The research by Buttifant & Hrysomallis (2015) investigated the effect of the various practical warm up protocols on acute lower body power. This is the comparison study between the elastic resistance band with box squat, barbell box squat, and a series of static stretching. The positive result found on the warm up with resistance band with box squat. The study showed a resistance band with a box squat gives an impact on vertical jump power. The result showed the flip side of the current which the current study founds insignificant result on the force, the height of the jump, and power output. The finding of the study by Buttifant & Hrysomallis (2015) found a positive impact due to the PAP influence the results as well as the intensity, volume, and rest period of the warm up protocol. According to a reviewed study by Wilson (2013) indicates that indicator that impacts the result of power performance is the intensity and volume of the warm-up, rest period length, and training status of the participants. The accurate and adequate intensity and volume of the warm-up, rest period length is needed to influence the performance.

In conclusion, the insignificant results found on the parameter height of jump, force, and power of the vertical jump may due to the protocol of warm up. However, the objective of this current study aimed to investigate the effect of different levels of resistance band towards the vertical jump performance. Hence, the warm up protocol was well planned according to the suggestion Bishop (2003). The different levels of resistance band may give and influence the same amount of force, power, and height of the vertical

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jump performance. May due to that reason, there are found the insignificant results of the study. Besides, the limitation of the study on the number of the sample size and individualize response might be influence the result. The vertical jump is the explosive power that required some factor that may impact the performance which the ratio of fast and slow-twitch muscle fiber and activation of lower body (Panoutsakopoulos et al., 2014). Hence, the background of the participant and the training status may affect the kinetics and kinematics output of vertical jump. Besides according to Voigt M, Simonsen EB, Dyhre-Poulsen P, Klausen K (1995) the effect of height jump on squat jump performance are depends on the muscular strength of leg extensor muscle.

5.2.1 Kinetic Output

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As the values of the result revealed in chapter four, the different levels of resistance band do not increase the kinetic output after the performing warm up protocol. The kinetic output has been measured in this study is power and force. The assumption of the result occurred may be due to the intensity and duration of warm up not affect the vertical jump performances. The added resistance band in the warm up protocol is mimicking the static stretching perhaps affect the length-tension relationship that will result in the strength of the participant. Thus, it may able to impair the force production on the vertical jump performances. As the study conducted by Loughran et al. (2017) showed the effect of static stretching which potentially induced the changes in muscle compliance gives a negative impact on measuring strength. The result of the study can be a reason as the protocol the warm up added with rubber band mimicries the elongation of the muscle tension.

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Besides, the protocol of warm up which added the resistance band as tool warm up may not strongly impact the force production on vertical jump performance. The insignificant result revealed in this current study may due to the warm up protocol of the current study. The rest period length of the warm up protocol does not enable it to affect the jumping performance. As mentioned in the reviewed study by Bishop (2003b), the recovery interval after the warm up is likely affecting the performance. Thus, adequate time to rest after performing the warm up is important due to the readiness to the performance as well as the resynthesize of phosphocreatine (Pcr) store.

The meta-analysis study by Gouvêa et al. (2012) in the Post Activation Potentiation (PAP) area was examined the effect of the rest intervals on jumping performance. This study review on 14 studies concluded that the eight to twelve minutes was the best interval between the PAP and the jumping performance. The study also revealed that zero to three minutes stated that the negative effect on jumping performance whilst a range of four to seven minutes found no changes in jumping performance. Hence, these findings of this study found the rest period affect the jumping performance. The rest interval from eight to twelve minutes found the positive effect towards the performance may due to adequate rest to perform the next physical activity. The range zero to three minutes was the too-short period which gives a negative impact of fatigue to perform the performance. As the study result found, it can be concluded that the rest period on the current study's warm up may not give beneficial to increase the performance.

Thus, the next researcher must watch out the rest period to look at the best result of the research. In this current study, the recovery duration between warm up and the vertical jump performance is 5 minutes. As the study from the Bishop (2003b) that has mentioned

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that the recovery time more than 5 minutes is adequate rest to performing the short term performance. It is due to the phosphocreatine (Pcr) store able to significantly restore. Thus, as followed by the reviewed study by Bishop (2003b) about warm up, the recovery time may be not a causes that affects force production on the jumping performance.

5.2.2 Kinematic Output

The kinematic performance measured is the height of the jump. The result of the height of the jump is the indicator measured in the vertical jump performance. The vertical jump is an explosive movement that needs certain force and power that results in the height of the jump. The well prepared before the execution of the jumping affects the result of the height jump. Thus, the current study measured the effect of warm up with the different levels of resistance bands on the height of the squat jump performance. The current result showed that there was no significant difference between the different levels of resistance bands on the height of vertical jump performance. The different level of resistance bands which represent the green, blue and orange bands provided the different hardness of the band as well as the different difficulty of stretching the band.

Even the resistance bands provide different resistance; the current study was showed no effect on the height of the vertical jump. Contrast with the finding of a study by Cilli et al., (2014) which resistant dynamic warm up increasing the height of the jump. However, this study has used the weighted vest as resistance in warm up protocol. The result of this study has shown a positive effect after the resistant dynamic warm up carried out the addition of 10% of body weight. The 10% percentages of the body weight were

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used as resistance on warm up has given a positive impact on the height of the vertical jump. In contrast with the finding of the current study, the resistance levels of resistance band maybe not enough to give a positive impact on explosive performance. Besides, the dynamic warm up added resistance band needs to change the protocol that may influence the performance of the participant.

Other than that, a negative result founds on the height jump performance may due to the protocol of warm up not able to influence the Post Activation potentiation (PAP) phenomenon. The review study from Obbs, Olusso, & Edewa, (2019) mentioned that the PAP enables to improve the jumping capabilities. As mentioned earliest, the PAP phenomenon is muscular contraction at the maximal or near-maximal intensities that able to elicit the force development. Thus, the current study of the warm up protocol added the different levels of resistance bands not enable to induce the PAP, which the inducing of the PAP enables to increase the force production as well as the height of the jump.

Force production affects the height of the jump performance. The height of jump performance needs a certain level of force production to execute the better performance of jump. Hence, Kraska et al., (2009) stated that the maximum effect of movement in vertical jump needs a certain level of force production. Thus, the result of the force that has already mentioned, which showed no significant effect between the different levels of the resistance band and force output. Hence, the different level of resistance was added in warm up routine produce the same force production may not diverse the result of the height of the vertical jump.

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5.2.3 Relationship of sRPE and Kinetic Output

The research question also questioned the relationship between the levels of sRPE after the warm up added resistance band with the level of kinetics output measured by the force plate during the vertical jump performance. In this research questions found that there is no relationship between the level of sRPE that rated by the participant after performing the warm up routine added resistance band with the level of kinetic output on vertical jump performances. The kinetic output measured is force and power. Hence, the result has shown no significant relationship between both variables. Thus, the level of intensity that rated by participants showed no impact on force and power. In the nutshell, this result does not support the idea that the sRPE that rated by the participant prior performing the warm up with the different level of resistance band gives a positive impact on the kinetic output on vertical jump.

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Nevertheless, the participant has rated the intensity of resistance on the right color of resistance. Which the result can be shown on the mean of the blue color resistance band that rated by the participant is rated as the mean 5.47 with ± .80 whilst the mean of the green color of resistance band is 3.59 with ±1.0. Then, the mean for the orange color of a resistance band that rated by the participant after performing warm up is 6.24 with ±0.56. As the sRPE value showed for the respectively color resistance band, that result indicated that the orange color of the resistance band is the hardest resistance band while the blue color or resistance is the medium. The green was shown the lowest result as it indicated that the low resistance band. The rating scale is from one to ten scales. Thus, this result supports the idea that the sRPE rated by the participant perceptive are based on the resistance band hardness. Even the sRPE has been rated by the participant on the right

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color resistance, but the sRPE show no relationship with the kinetic output which force and power.

5.3 Conclusions

The implementation of warm up is a crucial component prior to any physical activity. The different approaches of warm up protocol give different results on the physical performances. This current study has investigated the effect of warm up added the different levels of resistance band as a part warm up tool on squat jump performance. The overall result of this study has demonstrated that comparing the different levels of a resistance band that added during the warm up routine showed no significant difference in force, power, and height of vertical jump performance.

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The hypothesis in the current study has been determined from the significance level of ($p > 0.05$) as a different level of a resistance band that added during warm up protocol showed no effect on the kinetic and kinematic vertical jump performance. Hence, the different color of resistance which represents the different intensity of resistance band resulted in no significant difference on the force, power, and height of the vertical jump. However, the rate perceived exertion that used after performing warm up was shown that the green color of resistance is the lowest hardness, and then the blue color is the medium hardness while the orange color represents the most hardness of resistance band. As a result of the warm up shown, there is no effect on the level of RPE and the force and power performance of the participant.

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5.4 Recommendation

The findings of this study may provide knowledge on expanding future research to sports scientists. Besides, this discovery of this current research has provided new knowledge to the athletes, physical educators, coaches, and also students. The study of warm up is crucial things to explore among the sports scientist due to the importance of preparation before the commencement of any physical activity and competition. The well prepared of the warm up is needed to give a positive effect on the performance. Thus, in the future, the study of the warm up area needs to be continued to expand and update the information. The diverse study in warm up areas needs to explore in different sports areas.

Besides, in the future study, the researcher can choose more indicators to be analyzed because it can help to explain in detail the effect of the warm up. This current study has provided certain indicators in kinetic and kinematic performance. Hence, the future study needs to expand more the kinetic and kinematic variables. For example, relative peak ground reaction force (GRF), take-off velocity (TOV), and peak velocity (PV) which can explain more about the force production that may affect the height jump of the performance. The added more indicators in the future may help explore and explain the acute effect of the warm up area. Besides, the researcher can use the indicator angle of the joint that may affect the performance of the athlete. The different approaches of the angle of the joint may create different results of the performances.

The objective of the current study was to measure the effect of different levels of resistance band on kinetic and kinematics output. Thus, the study revealed that is an insignificant effect on the different level of resistance band as the warm up on kinetics and

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kinematics output of the vertical jump performance. The limitation of this study is not to measure the pre and post of the warm-up. Thus, the ability of the resistance band to warm up is not being able to measure. Hence, further research is necessary to confirm these findings on the ability of the warm up that added the resistance band. In the future of the study can investigate the pre and post effects of the warm up with added the resistance band. Besides, the expanding of the further research can be selecting the participant in the elite population, and to investigate its practical application in professional team-sport competition.

In the nutshell, it is necessary to further the current study due to explore more knowledge about the warm up area added the resistance band as a warm up tool. Hence, it is recommended to further study the current study with the extent to the range of athletes, larger sample size, and further exploration of any potential individualized responses. Therefore, the collection of the study may beneficial for sports scientists. Further study on the additional resistance band in the warm up area is important for optimizing the ability of the resistance band.

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APPENDIX A

CONSENT FORM

INFORMATION SHEET FOR PARTICIPANTS or PARENTS / CAREGIVERS ETC.

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not to participate. If you decide to participate we thank you. If you decide not to take part there will be no disadvantage to you of any kind and we thank you for considering our request.

What is the Aim of the Project?

This project is being undertaken as part of the requirements for postgraduate.

What Type of Participants are Needed?

Recreationally active combat sports athletes' males who age from 20 to 25 will be selected to participate in the study. Participation will be volunteered in nature; with withdrawer can be done at any time without the need for any reasons whatsoever to be given. A written consent form will be explained and fill-up by selected participants if they agreed to participate. The approval process for research work to be done will be sought after from the Faculty of Sports Science & Coaching, Sultan Idris Education University.

What will Participants are asked to do?

Should you agree to take part in this project, you will be asked.

The Participant needs to attend four sessions in this research. Not involving other research projects during the implementation of research.

The participant needs to follow all the instructions that will be given in the sessions.

Reference to any potential harm or discomfort and any benefit to the participant.

Please be aware that you may decide not to take part in the project without any disadvantage to yourself of any kind.

Can Participants Change their Mind and Withdraw from the Project?

You may withdraw from participation in the project at any time and without any disadvantage to yourself of any kind.

What Data or Information will be collected and What Use will be made of it?

Name age, height, and body weight information will be taken in this study

The video performing the vertical jump will be taken to measure the kinematic variable.

The data of the participants only will be used by the researcher

Results of this project may be published but any data included will in no way be linked to any specific participant.

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You are most welcome to request a copy of the results of the project should you wish.

The data collected will be securely stored in such a way that only those mentioned above will be able to gain access to it. At the end of the project, any personal information will be destroyed immediately except that, as required by the University's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

What if Participants have any Questions?

If you have any questions about our project, either now or in the future, please feel free to contact either:-

Nursyaidatul Hafiza binti Madzlan

Department of Sports Science and Coaching, Sultan Idris Education University.

Telephone Number: - 019-9377471

or

Assoc. Prof Dr. Nur Ikhwan Bin Mohamad

Department of Sports Science and Coaching, Sultan Idris Education University

This project has been reviewed and approved by the Ethics Committee of the Faculty of Sports Science & Coaching, Sultan Idris Education University.

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THE EFFECT OF THREE DIFFERENT RESISTANCE LEVEL OF USING RUBBER BAND AS PART OF WARM UP TOOL ON VERTICAL JUMP PERFORMANCE

CONSENT FORM FOR

[*PARTICIPANTS or PARENTS / CAREGIVERS ETC*]

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:-

1. My participation in the project is entirely voluntary;

2. I am free to withdraw from the project at any time without any disadvantage;

3. The data (*video-tape/audio-tapes*) will be destroyed at the conclusion of the project but any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed;

4. The results of the project may be published but my anonymity will be preserved.

I agree to take part in this project.

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.....

Signature of participant Date:

This project has been reviewed and approved by the Ethics Committee of the Sultan Idris Education University.

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APPENDIX B

NORMALITY TEST

The normality test is the preliminary analysis conducted to determine the normality of the data. The data under normal distribution assume the population in which the sample was drawn was normally distributed. The normality of the data was determined through the significant value of either Kolmogorov-Smirnov or Shapiro-Wilk. If the sample size is less than 50, the Shapiro-wilk outcome will be referred while the Kolmogorov-Smirnov outcome will be referred to if the sample size is more than 50 (Mayers, 2013). Thus, this current was chosen as the value from Shapiro-wilk because the sample of this study was a small group. The samples were less than 50. Then, the data can be considered as normally distributed if the significant value of both statistical analyses was more than 0.05 (Pallant, 2005).

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Table 1

Normal distribution table of the parameter

Parameter	rubber band	Shapiro Wilk			Mean
		Statistic	Df	Sig.	
Force	Blue	.952	17	.493	1532.02
	Green	.936	17	.278	1507.25
	Orange	.956	17	.558	1511.66
Power	Blue	.968	17	.784	3256.67
	Green	.944	17	.370	3296.12
	Orange	.958	17	.601	3384.62
Height of jump	Blue	.936	17	.270	37.85
	Green	.942	17	.341	36.34
	Orange	.980	17	.953	36.59

** Significant level for normality was <0.05*

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Table 1 above presented the normal distribution of the data on warm up with the different colors of the rubber band and the parameter of the study which includes the data of force, power, and height of the jump. Based on Table 1, the sample size for the current study was less than 50, so the data of normality was taken from the Shapiro-Wilk analysis.

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APPENDIX C

Session Rate Perceived rate (sRPE)

RPE	Description
0	complete rest
1	very, very easy
2	easy
3	moderate
4	somewhat hard
5	hard
6	
7	very hard
8	
9	
10	extremely hard (almost maximal)

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APPENDIX D

Pictures during data collection



Image 1: the participant ready for performing the squat jump test.

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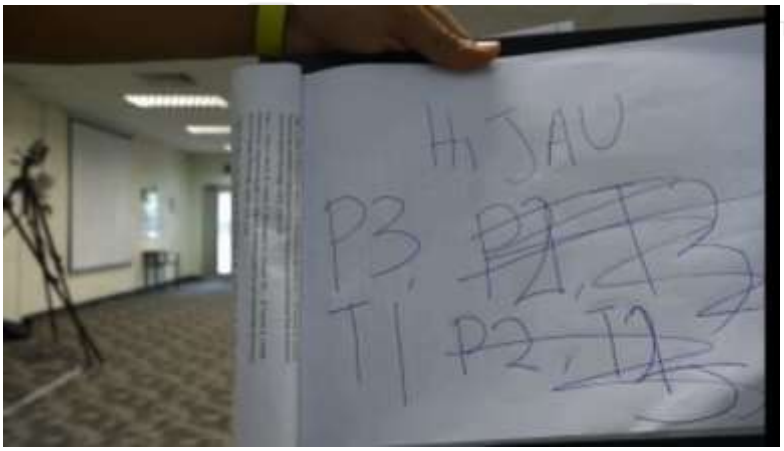


Image 2: the camera view in started the squat jump test.

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