LER CHAI HONG

EFFECT OF MC ON STRENGTH AND DYNAMIC BALANCE

2022

EFFECT OF MENSTRUAL CYCLE ON MUSCLE STRENGTH AND DYNAMIC BALANCE AMONG RECREATIONAL BASKETBALL PLAYERS

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EFFECT OF MENSTRUAL CYCLE ON MUSCLE STRENGTH AND DYNAMIC BALANCE AMONG RECREATIONAL BASKETBALL PLAYERS

By

LER CHAI HONG

A Research project submitted to the Department of Physiotherapy,
M.Kandiah Faculty of Medicine and Health Sciences,
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in partial fulfillment of the requirements for the degree of Bachelor of Physiotherapy (HONOURS)

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EFFECT OF MENSTRUAL CYCLE ON MUSCLE STRENGTH AND DYNAMIC BALANCE AMONG RECREATIONAL BASKETBALL PLAYERS

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ABSTRACT

Background and Objective: Menstrual cycle is represented by a biological pattern formed by the cyclic variation of the endogenous sex hormones known as estrogen and progesterone. Different phases will have varies of hormones fluctuation thus the effect of the hormonal fluctuation might lead to sports injuries. This research is conducted to investigate the different across early and late follicular phase of menstrual cycle on muscle strength and dynamic balance among recreational basketball players.

Methods: A total of 17 recreational basketball players (Age 21.05 ± 0.91years; Height 1.62 ± 0.05 m; Weight 53.42 ± 7.52 kg) with a self-reported regular menstrual cycle participated in this study. Their muscle strength and dynamic balance were measured on their day 1 and day 12 of menstruation. Muscle strength was measured by using Handheld Dynamometer (HHD). Dynamic balance was measured by using Y-Balance test.

Results: The main finding were as follow: (1) there was no significant effect across early follicular phase as well as late follicular phase on participant's muscle strength ($p>0.05$), (2) dynamic balance of participants shown a significant difference in late follicular phase compared to early follicular phase ($p<0.05$).

Conclusion: This study reveals no significant different across early and late follicular phase of menstrual cycle on muscle strength but there was a significant different across early and late follicular phase of menstrual cycle on dynamic balance in dominant leg among recreational basketball players. This research would be advantageous for the recreational basketball player to take note of their poor balancing during the follicular phase. Balance training can be considered to avoid fall and lower extremity injuries.

Keywords: Menstrual cycle, Muscle strength, Dynamic balance, Recreational basketball players

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As our study endeavour comes to an end, I would want to express my heartfelt appreciation firstly to all the participants who are willing to be involved in my research, without whom none of this would be possible. I truly appreciate the time and effort they have provided.

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Lastly, I would like to express my gratitude to my friends and family for their unwavering support and understanding throughout the study project's development. Some of them even spent their time together to produce the research project.

APPROVAL SHEET

This Research project entitled "**EFFECT OF MENSTRUAL CYCLE ON MUSCLE STRENGTH AND DYNAMIC BALANCE AMONG RECREATIONAL BASKETBALL PLAYERS"** was prepared by LER CHAI HONG and submitted as partial fulfilment of the requirements for the degree of Bachelor of Physiotherapy (HONOURS) at Universiti Tunku Abdul Rahman.

Approved by:

_____

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UNIVERSITI TUNKU ABDUL RAHMAN

Date:

PERMISSION SHEET

It is hereby certified that **LER CHAI HONG** (ID No: **20UMB06245**) has completed this Research project entitled "EFFECT OF MENSTRUAL CYCLE ON MUSCLE STRENGTH AND DYNAMIC BALANCE AMONG RECREATIONAL BASKETBALL PLAYERS" under the supervision of MR MUHAMMAD NOH ZULFIKRI BIN MOHD JAMALI (Supervisor) from the Department of Physiotherapy, M. Kandiah Faculty of Medicine and Health sciences.

Yours truly,

(LER CHAI HONG)

DECLARATION

I hereby declare that the Research project is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UTAR or other institutions.

Name: LER CHAI HONG

Date:

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LIST OF ABBREVIATIONS

MC	Menstrual Cycle
UTAR	Universiti Tunku Abdul Rahman
FIBA	International Basketball Federation
NBA	National Basketball Association
EFP	Early Follicular Phase
LFP	Late Follicular Phase
SEBT	Star Excursion Balance Test
HHD	Hand-held dynamometer
ASIS	Anterior superior iliac spine
M	Mean
SD	Standard Deviation
D	Dominant leg
ND	Non-dominant leg
CSR	Conventional strength ratio
1RM	One Repetition Maximum

CHAPTER 1

BACKGROUND

1.1 Chapter Overview

This chapter will outline the background of the study, stating out the problem statement and research question. Then, aims of the research, research objectives as well as the hypotheses will be discussed. After the operational definition of terms for the research study, the rationale and the scope of the research also will be discussed.

1.2 Background of Study

Basketball is one of the famous contact sports worldwide as the total of 11% of the world's population are participating in basketball. (Kilic et al., 2018; Siupsinskas et al., 2019). Since 1932, the International Basketball Federation (FIBA) united 8 countries and currently there are more than 450 millions of registered players (International Basketball Federation, n.d.). However, these number do not include recreational players yet. Therefore, we can assume that there are still tremendous of recreational basketball players out there and perhaps they are under the influence of National Basketball Association (NBA) basketball players (Moore et al., 2021). Moreover, after the men and women's basketball championship has been done, the more the participation of both gender as this sport has been introduced into different level of education as well as to the community (Harmer, 2005).

As the participation of players is increasing year by year, so then the incidence of injuries are also increasing. Apart from that, basketball has evolved from non-contact based sport to a contact sport, players will be trained to utilise their body figure to their maximum extend and will be taught of some contact maneuvers that make their team more easier to shoot the ball (Drakos et al., 2010). Some of the basketball players will also imitate those steps or drills that demonstrated in NBA games. Actually basketball is a sport that require frequent jumping, turning and the necessity of explosiveness in fast changing in direction to dodge away from opponent. Due to the high intensity of the motions, it is not only being known as a sport with the highest rate of injury among non-contact sport, but also being classified as a more dangerous sport when compare to many other contact sports (Kilic et al., 2018 & Moore, et al., 2021).

Many researches have proved that basketball is at high risk of musculoskeletal injuries in different population including pediatrics, high school, collegiate, adult, professional, and recreational players. The most prevalence injuries occurs among them are lower extremity injuries. Among all types of lower extremity injuries, ankle injury is the one with the highest rate of occurrence (Herzog et al., 2019; Moore et al., 2021; Owoeye et al., 2021; Pasanen et al., 2018; Schepens et al., 2020; Tummala et al., 2019; Zuckerman et al., 2018 & Zynda et al., 2022). When compare between gender, the injury rate is actually much more higher in female basketball players than male basketball players (Borowski et al., 2017; Harmer , 2005; Siupsinskas et al., 2019).

For all of the females, they are constantly undergoing menstrual cycle every month since puberty. Menstrual cycle happens along with the fluctuation of hormones for example estrogen and progesterone. The changes of hormones can lead to some physiological changes as well, thus the effect of menstrual cycle on sports performance including reduced strength (Okazaki et al., 2017 & Romero-Moraleda, 2019), reduced balance (Lee & Petrofsky, 2018), reduced joint laxity (Yamazaki et al., 2021), increased postural sway (Friden, 2003; Lee & Yum, 2016; Yim et al., 2018) as well as affecting neuromuscular activity of muscles (Khowailed, 2015).

1.3 Problem Statement

To date, these articles mentioned above are established in different population for instance healthy young women or young physically active women or healthy female runners. Besides, they studied in different muscles groups for instance hamstrings (Miyazaki & Maeda, 2022), quadriceps (Domínguez-Navarro et al., 2022; Romero-Moraleda et al., 2019), plantar fascia (Lee & Petrofsky, 2018) and anterior cruciate ligament (Dos Santos Andrade, 2016; Herzberg et al., 2017; Khowailed e al., 2015). Hence, there is limited research (Khowailed et al., 2021; McKay et al., 2001) focusing on recreational basketball players as well as in ankle muscles. Therefore, the purpose of this study is to investigate the differences across early and late follicular phase of menstrual cycle on muscle strength and dynamic balance among recreational basketball players.

1.4 Research Question

Is there any different across early and late follicular phase of menstrual cycle on muscle strength and dynamic balance among recreational basketball players?

1.5 Aim & Objectives

Aim

To investigate the different across early and late follicular phase of menstrual cycle on muscle strength and dynamic balance among recreational basketball players.

Objectives

1. To explore different across early and late follicular phase of menstrual cycle on muscle strength among recreational basketball players.
2. To explore different across early and late follicular phase of menstrual cycle on dynamic balance among recreational basketball players.

1.6 Hypothesis

H0i) There is no significant difference across early and late follicular phase of menstrual cycle on muscle strength among recreational basketball players.

H1ii) There is significant difference across early and late follicular phase of menstrual cycle on muscle strength among recreational basketball players

H0ii) There is no significant difference across early and late follicular phase of menstrual cycle on dynamic balance among recreational basketball players.

H1ii) There is significant difference across early and late follicular phase of menstrual cycle on dynamic balance among recreational basketball players.

1.7 Operational Definition

1.7.1 Menstrual Cycle

A cycle that lasts for 38 to 35 days that shows the series of changes in woman's body every month in order to prepare their body for possibly pregnancy. (McNulty et al., 2020)

1.7.2 Early Follicular Phase

The first phase occurred in menstrual cycle. It begins on the first day of the cycle and finishes once there is an increase in estrogen level. The main characteristics of this phase is the increased level of FSH and LH. The phase will be determined by self-reported method where participants will report themselves on their first day of their menstruation. (McNulty et al., 2020)

1.7.3 Late Follicular Phase

The late follicular phase begins when the estradiol level is rising and finishes at its preovulatory peak. The important activity here will be the increased oestradiol and decreased FSH and LH levels. The phase will be determined by self-reported method where participants will report themselves on their 12^{th} day of their menstruation. (McNulty et al., 2020)

1.7.4 Muscle Strength

The ability to move and lift object (Crinkleton, 2019).

1.7.5 Dynamic Balance

The ability to maintain in a stable position while we are moving or ambulating ourselves from one place to another (Physiopedia, n.d.).

1.7.6 Recreational

An individual who involving in some exercises or activities for enjoyment and fun (Collins, n.d.).

1.8 Rationale of Research

The only study conducted towards recreational players is to determining the ankle injuries in basketball, which is a study done by McKay et al. (2001). However, the objectives of the study is to determine the rate of ankle injury and to identify the possible risk factors of injuries. This research is conducted in the recreational basketball players as there is a lack of study that investigating the effect of menstrual cycle in their population even though basketball is reported in the top ten sports that suffering ankle injuries. By doing this research, understanding of female recreational players towards effect of menstrual cycle will be enhanced. Since they are aware of it, rate of ankle injuries might be decreased. This research will also help medical practitioners to be more aware of physiological effects of menstrual cycle towards female basketball players. From here, they can come out with the balance and strengthening training program to the population to decrease the rate of ankle injuries.

1.9 Scope of the Research

The research is focusing on the effect of menstrual cycle on muscle strength and dynamic balance among recreational basketball players. As every girls will undergo menstrual cycle and it is actually affecting our physiological changes thus the effect of menstrual cycle is believed that it influence athletes too. In this study, muscle strength of ankle stabilizing muscles and dynamic balance will be measured as the previous research are still having contradictory. Then, the population will be narrowed and focused in recreational basketball players who are never participated in any state, national or international basketball competition as they are also prone to get injuries during the playing session.

CHAPTER 2

LITERATURE REVIEW

2.1 Chapter Overview

This chapter will discussed about the different topic through past journal and literature which related to the current study and thus provided the framework for the research project.

2.2 Prevalence of ankle injuries in female basketball players

In 1970s, basketball is one of the top seven sport reported as the sport that owns a higher percentage of ankle injuries at about 79% injuries (Fong et al., 2007). Prevalence of ankle sprains in basketball shows a percentage of more than 80 percent among the 70 sports that is being analysed. Throughout this year, there are a variety of studies show that the prevalence of ankle injuries in different population of elite basketball players which include youth players, adolescent players, collegiate players and also international players.

According to Borowski et al. (2008), research done on United State high school basketball players where their injury rates and the different injury pattern due to gender and type of exposure, at last the rate of injury is higher in girls

than boys. In the study of Siupsinskas et al. (2019) also proved that among the adolescents players, there is a 3 to 5 fold difference in female players than male players in developing ankle injuries. Lower extremities injuries are common in both Women's NBA and NBA players but women are more prone to injuries compare with NBA players. According to Owoeye et al. (2020), it is a research on receiving all types of injuries from youth basketball players. In female players, ankle represent 45%, which is the highest percentage of the injured body sites.

As we can see that almost all the studies above are showing that the prevalence of ankle injuries among female basketball players and it is still increasing year by year (Moore, et al., 2021). However, there are quite lack of research to investigate or work on the female athletes. More studies are focused among male basketball players, or working on those elite basketball players in different level but not recreational basketball players.

2.3 Effect of menstruation on muscle strength among athletes

There are several studies working on the effect of muscle strength across menstrual cycle, the result are left contradictory where Friden et al.(2003) and Romero-Moraleda et al. (2019) saying that there is no significant change in muscle strength across the menstrual cycle. Friden et al. (2003) focused on quadriceps muscle while Romero-Moraleda focused on lower limb muscles including quadriceps, hamstrings, glutes, hip flexors, calves and core muscles.

In the study of Andrade et al. (2017), the finding states that there is a lower hamstring-to-quadriceps peak torque strength balance ratio during follicular compared to luteal phase. For dominant leg, there is no differences between luteal and follicular phase. Similar finding found in the study of Miyazaki & Maeda (2022) that the strength of hamstring is weaker in the ovulation phase compared to luteal phase. Same goes to the study in Pallavi et al. (2017), the finding shows that the strength of the muscles are higher during the follicular phase due to the increased hormones.

However, weaker muscle strength is found in the study of Okazaki et al. (2017) during luteal phase, which means that risk of ankle injuries is higher during luteal phase.

2.4 Effect of menstruation on dynamic balance among athletes

In the study of Ericksen et al. (2012), they are examining the potential hormone contributions to ankle laxity and dynamic postural control during the preovulatory and postovulatory phases. The result shows that dynamic postural control is not affected even though there is laxity present in ankle inversion-eversion. In this study, they are using Star Excursion Balance Test (SEBT) to measure dynamic balance. However, the latest reliable instrument for dynamic balance is Y-Balance test which will be used in my study later.

According to Lee & Yim (2016), postural sway increases in the ovulation phase which means that the balance of the participants is unstable during ovulation phase. In the research by Lee & Petrofsky (2018), result shows the higher postural sway and tremor were greater during ovulation phase than that in menstruation in women. Similarly to the previous finding, there is also a higher postural sway in ovulation phase in the study done by Yim et al. (2018). This is due to the reason that the level of estrogen is increasing in ovulation phase and hence influence the postural instability indirectly. However, there is also a study clarifies that stability is much more unstable in mid-luteal phase but the study is done under the influences of premenstrual symptoms (Friden et al., 2003).

CHAPTER 3

METHOD AND METHODOLOGY

3.1 Study Design

This study was a cross-sectional study.

3.2 Setting

Study was conducted at Physiotherapy Centre, 3rd floor, KA block of Universiti Tunku Abdul Rahman (Sungai Long Campus).

3.3 Study Population

The population of the study was female recreational basketball players around Selangor area.

3.4 Sample size

Sample size was determined by using GPower 3.1 software. Significant level was set at 0.05 and the power was set at 0.80. Hence, the total sample size obtained is 15 and to include the 10% of participant drop-out rate, a total of 17 participants was required to reach the statistical power of 82%. (Lee & Yim, 2016)

3.5 Sampling Method

Simple random sampling method was used in this research.

3.6 Inclusion criteria

1. Females who do not use oral contraceptives
2. Menstrual status (eumenorrheic women)
3. Playing basketball for at least once a week

Participants have to be free from oral contraceptives, this is due to the reason that oral contraceptives will inhibit the secretion of estrogen during their menstrual cycle (Elliott-Sale, 2020) thus affecting the study's result. A normal menstrual status of participants was required in order to explore the objective of the study. As the population was recreational basketball players, only the participants who played basketball for at least once a week can be recruited.

3.7 Exclusion criteria

1. Female players who involved in state, national or international level of competition
2. Females who are having menstrual-related dysfunctions such as amenorrhea or pregnancy

State, national or international players were excluded in the research as they were trained for competition. Therefore, they were not considered as recreational players but professional players. Females who were having menstrual-related

dysfunctions will have the unstable hormonal changes which will affect the result of the research.

3.8 Instrument

1. Hand-held dynamometer (HHD)

   Strength of the ankle plantarflexor (gastrocnemius) & dorsiflexor (tibialis anterior) was measured using HHD. The test started by holding the HHD in stationary state on the specific point of the muscles being measured. While the clinician was applying a force towards participants, participants had to against the force at their maximum. Participants were required to perform 3 times of muscles contractions and maintained for 5 seconds for a single time in order to get an accurate reading by calculating the average value. Besides, the clinician have to be strong enough to against the force generated by participants (Delaware Physical Therapy Clinic, n.d.).

   Scoring & Interpretation:

   The validity as well as the intra- and inter-rater reliability of HHD on ankle dorsiflexors and plantarflexors are being done by Hebert et al. in 2011 (ICC=0.67), Mentiplay et al. in 2015 (ICC=0.31-0.79), Spink et al. in 2012, Davis et al. in 2017 (ICC=0.96-0.98), and Kimura et al in 2018 (ICC=0.94-0.96) .

2. Y-balance test

Y-balance test is a reliable test for functional lower extremity strength and balance related to risk of injury (Linek et al., 2017; Powden et al., 2019). In the research done by Linek et al. (2017), the reported ICC=0.57-0.82 while the ICC value in the research of Powden et al. (2019) is reported from 0.57 to 0.82. Dynamic balance can be tested by using Y-balance test which had been modified from Star Excursion Balance Test (SEBT). Participant was required to stand on one foot and used another foot to reach out to 3 specific direction which were anterior, posteromedial and posterolateral directions. These 3 directions will then being calculated and the value was known as composite reach distances which was good in predicting injury. During the test, participants are required to perform a total of nine times in order to meet the reliability of the test. Therefore, participants need to perform 6 times for familiarization and the last 3 times for data recording for each of the directions. After the data recording session, the average composite score reached distance will be calculated.

Scoring and Interpretation:

The composite score was calculated first by multiplying participants' limb length by 3, then dividing the sum of the 3 reach directions by the number and lastly multiplied 100. To interpret the findings, the final result that less than 80%, it meant that the participant has high risk of injury as well as poor single leg balance (Walker, 2016).

3.9 Procedure

Before the recruitment of participants, inclusion and exclusion criteria were verbally confirmed. After confirmation of involving in the study, a google form was sent to the participants. The consent form of participants, and the personal data protection notice were attached in the google form. Participant's demographic data including age, height, and weight and data on menstrual cycle period length for August, September, October were also attached in the google form. After filling the google form, participants will be briefed through the procedure of the research. This study is divided into two session. For the first session, it will be on the first day of their menstrual cycle, known as early follicular phase and the second session will be on the 12^{th} day (late follicular phase) of the menstrual cycle. Self-reported menstrual cycle techniques was used thus participants had to report themselves on their first day and the 12^{th} day of their menstrual cycle. Upon reaching the physiotherapy centre, the assessment will start by measuring their true limb length of both legs, followed by assessing their ankle muscle strength using HHD and assessing their dynamic balance using Y-balance test..

- Measure true limb length

  Value of true limb length is needed to calculate the dynamic balance score of the participants. Participants will be in supine lying on the couch. A measuring tape is used to measure participant's true limb length which is the distance from their anterior superior iliac spine (ASIS) to medial malleolus. The measurement in centimetre will be recorded. The value

will then be put into the formula mentioned above to obtained the scoring of Y-balance test.

- Assessment of ankle muscle strength

  Participants will be assessed in plantarflexion then proceed to dorsiflexion.

  For plantarflexion, participants was in supine position, lower limbs in neutral position with their hip and knee extended. Participant's tested foot was required to be at the edge of the couch, non-test foot was required to be in flexed position. Clinician stood at the end of the table, facing cephalic to participant. One of the clinician's hand held HHD while another hand stabilizing the tested leg just above the ankle joint. Another option can be chosen where stabilizing belt was chosen to stabilize the tested leg. Then, HHD will be placing at the plantar surface of the tested leg, proximal to the first metatarsal head. Direction of force will be perpendicular to metatarsal.

  For dorsiflexion, participants was in supine position as well, lower limbs in neutral position with their hip and knee extended. Participant's tested foot was required to be at the edge of the couch, non-test foot was required to be in flexed position. Clinician stood beside participant, facing caudal to participant. One of the clinician's hand held HHD while another hand had to stabilize the tested leg just above the ankle joint. Another option can be chosen where stabilizing belt was chosen to stabilize the tested leg. Then, HHD will be placing at the dorsal surface

of the tested leg, opposite position as in plantarflexion. Direction of force was the same as in plantarflexion

All the data were recorded into excel after each attempt.

- Assessment of dynamic balance

  Y balance test was carried out by using the Y-balance test instrument, came with the angulation of 90 degree and 135 degree in between. Participants had to perform the test with barefoot. Firstly, they will be standing with one foot first behind the line presented on the box at the center with their hands placing at waist level for stabilizing purpose. Then, participant was instructed to push the box as far as possible in terms of their balance was reserved. Participant will go through the familiarization stage with the 6 attempts in each directions started from anterior direction then to posterolateral and lastly to posteromedial directions, for both legs. After that, participant was allowed to rest for a few minutes then proceed to the following 3 attempts for data recording. Stepping or shifting weight to the non-dominant leg is not allowed during each attempt. If participants released their hands from their waists or the weighing foot was raised off the ground or they were unable to go back to starting position throughout the attempt, the trial considered fail and participants need to start over. The farthest distance attained for each directions were noted. Then, repeat the whole cycle with another leg. Make sure the measurement will be taken for three times and their average value was calculated. The average distance will then put into Y-

Balance test formula and the final score of difference in percentage was calculated.

3.10 Statistical analysis

All the data collected in the study was transferred into Microsoft Excel and then analysed by using IBM Statistical Package for Social Science (SPSS) software version 26.0 to produce study findings. For the demographic data of the participants such as age, sex, height and weight, descriptive statistical analysis was chosen to obtain the mean and standard deviation. For continuous data, normality test was assessed by using the Kolmogorov-Smirnov test. P-value of each variables are more than 0.05 where the data are normally distributed. Hence, parametric test was applied. (changes in hamstring flexion) A paired sample test was chosen to compare the mean score of dynamic balance and muscle strength within the same individuals on their early and late follicular phase. Additionally, association between muscle strength and dynamic balance in different phase was carried out by using the Pearson's correlation test. The level of confidence was set at $\alpha < 0.05$.

3.11 Ethical approval

This study was participated to ethical approval by the Scientific and Ethical Review Committee (SERC) of Universiti Tunku Abdul Rahman (UTAR). Informed consent was given to the participants, they signed the form which indicated they were agreed to involve in the research. Participants owned the right to withdrawn from the study anytime.

CHAPTER 4

RESULTS

4.1 Chapter overview

This chapter will be featuring the findings and the statistical analysis after the data collection process for the research project. First and foremost, demographic data is presented and followed by ankle muscle strength result as well as Y-balance test score. Hypothesis is tested and also being elaborated. The data presentation of the result will be presented in a sequence of an overall tabulated result, followed by relevant graph, if any. Then, explanation will be attached below the presented graph.

4.2 Demographic Data of the Participants

Table 4.1 Characteristics of participants (N=17)

Demographic data	**Mean ± SD**
Age, year	21.05 ± 0.91
Height, meter	1.62 ± 0.05
Weight, kg	53.42 ± 7.52
BMI, kg.m^2	16.47 ± 2.2
Average of Cycle Lengths	32 ± **2**

Table 4.1 shows the demographic data of 17 female basketballers participated in this research. The mean and standard deviation of age, height, weight, BMI and the cycle length are presented. All the participants are recruited in Klang Valley area who are a recreational basketball player that play basketball at least once a week. They are also having normal menstrual status from the past 3 consecutive months and free of oral contraceptives or other hormone-stimulating medications for the 6 months before the study. None of them are having a pregnancy.

4.2.1 Age of the Participants

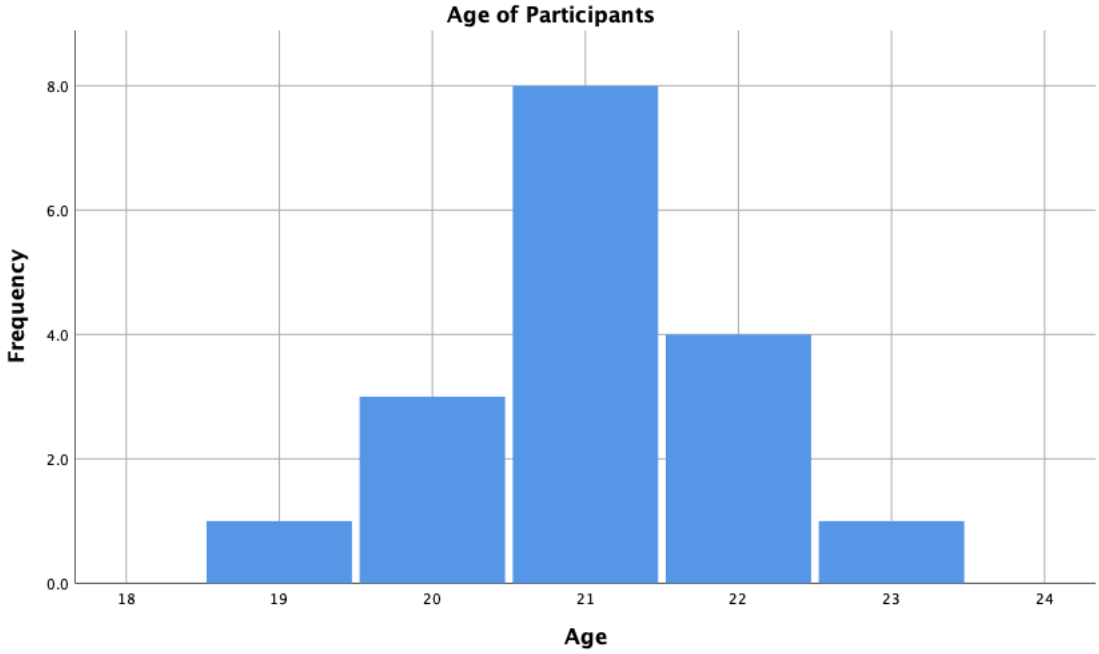

Figure 4.1 Bar Chart Distribution of the Participants' Age

Figure 4.1 illustrates the age of the participants involved in this research. Most of the participants are 21 years old, make up a total of 10 people or 52.6% of the data. There are 4 people in aged 22, makes up to 21.1% while 3 or 15.8% of people are 20 years old. Last but not least, both the 19-year-old participant and 23-year-old participant has the same number of participants which is only one participant and they constituted 5.3% of total participants.

4.2.2 Height of the Participants

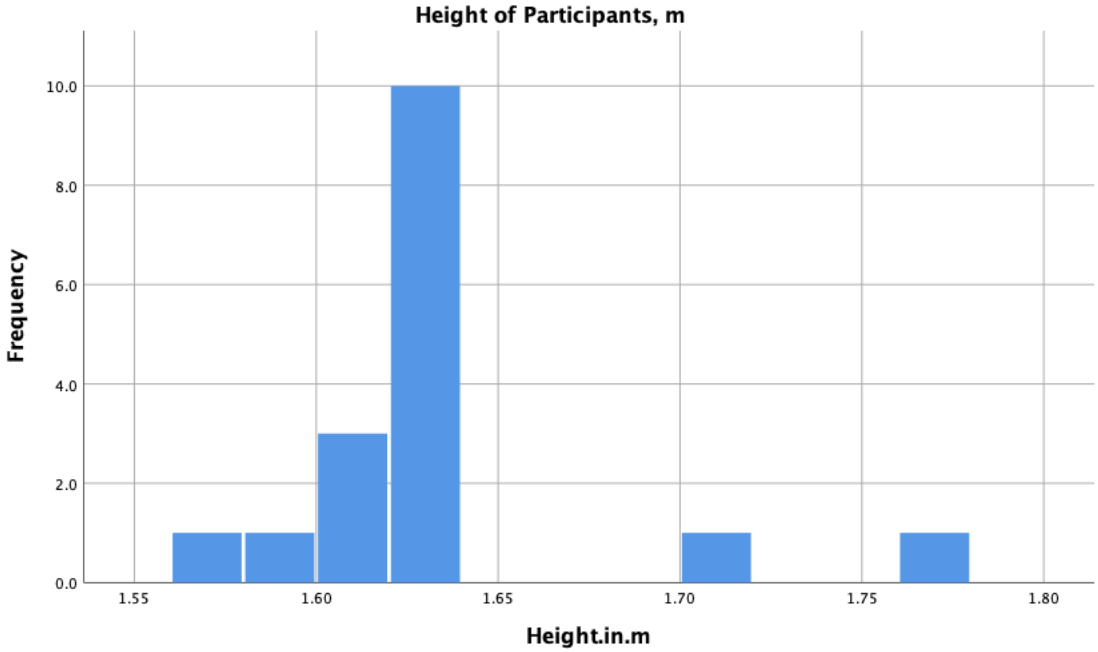

Figure 4.2 Bar Chart Distribution of the Participants' Height

Figure 4.2 illustrates the involved participant's height, in metres. The highest amount of participants is the height of 1.63 metres. It consists 35.3% of the overall data, represented by 6 participants. Second high of the number of participants' height is 1.62 metres which constituted 23.5% of total participants. Moving on to the third height within the recruited participants wasis 1.60 metres, 2 or 11.8% of participants reported this height. Next, the following listed height is occupied by only one participant including 1.57 metres, 1.58 metres, 1.61 metres, 1.71 metres and 1.76 metres. Each of the height constitutes the percentage of 5.9% to the overall percentage.

4.2.3 Weight of the Participants

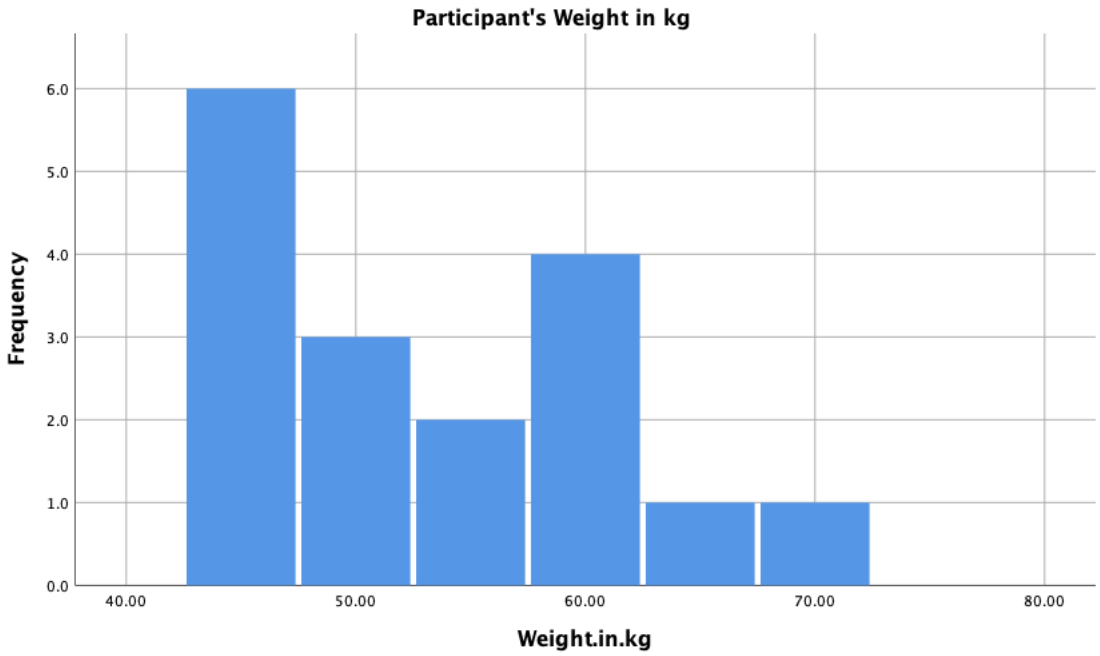

Figure 4.3 Bar Chart Distribution of the Participants' Weight

Figure 4.3 illustrates the recruited participant's weight in kilogram. The highest amount of participants is 6 participants with the weight of 45kg, 46kg and 47kg. It contributes 35.4% to the overall percentage. Followed by the weight of 58kg, the second highest weight that reported by the recruited participants. Participants with 58kg contributed 11.8% in the overall percentage. Next, the following listed weight is occupied by only one participant including the weight of 48 kilograms, 51 kilograms, 52 kilograms, 54 kilograms, 55 kilograms, 61 kilograms, 62 kilograms, 66 kilograms and 70 kilograms. Same goes to the height, each of the listed weight with one participant constitutes the percentage of 5.9% to the overall percentage.

4.2.4 BMI of the Participants

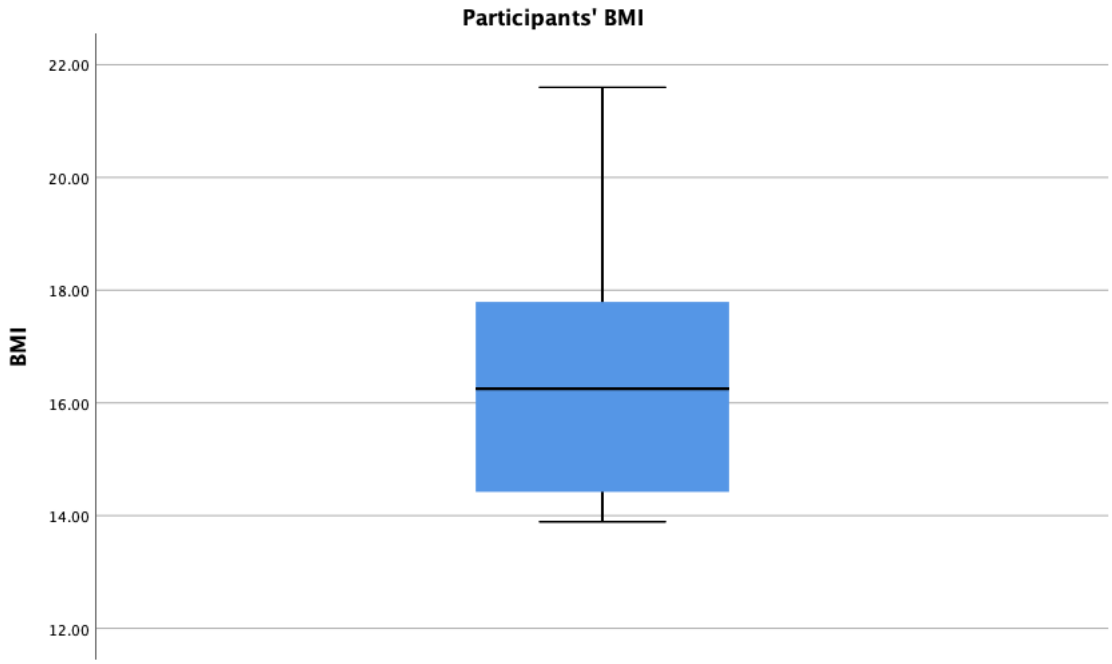

Figure 4.4 Box Plot of the Participants' BMI

Figure 4.4 is a box and whisker plot showing the BMI of the participants. From the box plots, we can observed the minimum BMI of the participants is 13.89 $kg.m^2$ and the maximum BMI of the participants is 21.60 $kg.m^2$. Besides, the median of the data also can be obtained which is 16.14 $kg.m^2$. The first quartile of participants' BMI is 14.42 $kg.m^2$ while the third quartile of participants' BMI is 17.79 $kg.m^2$. Another information we can observed from the box plots is the interquartile range of BMI, it is 3.37 $kg.m^2$ in this data set. For this data, there is no outliers presented.

4.2.5 Average Cycle Length of the Participants

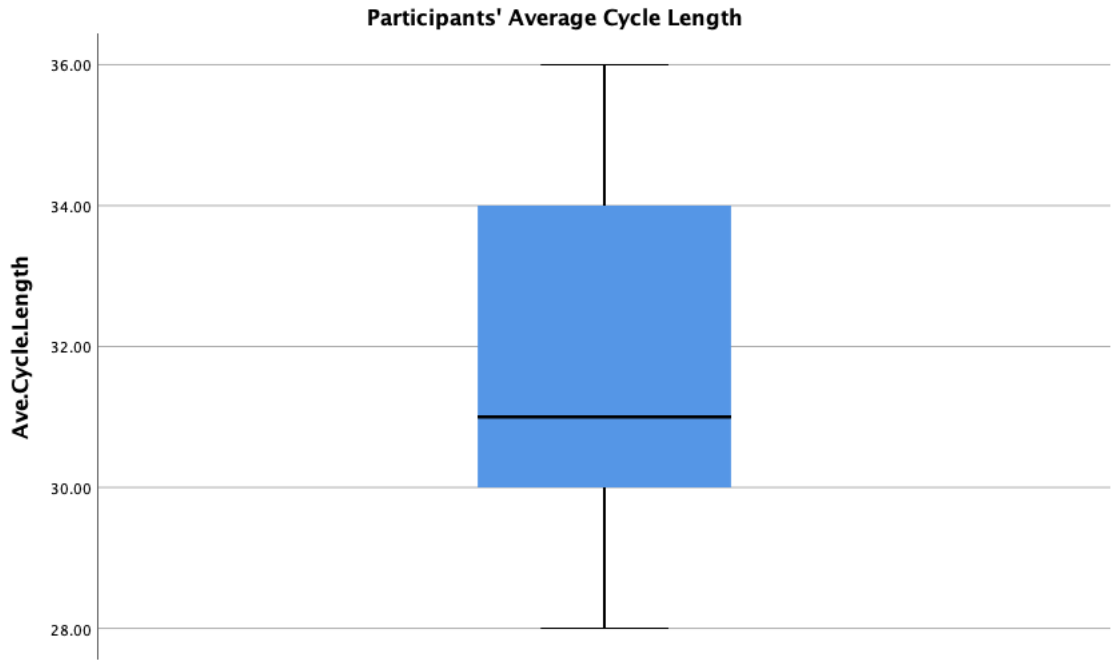

Figure 4.5 Box Plot of the Participants' Average of Cycle Length

Figure 4.5 is a box and whisker plot showing the average cycle length of the participants. From the box plots, we can observed the minimum average cycle length of the participants is 28 days and the maximum average cycle length of the participants 36 days. Moving on to the next information, median of the average cycle length is 31 days. Next, the first quartile of the average cycle length of participants is 30 days while the third quartile of is 34 days. Another information we can observed from the box plots is the interquartile range of average cycle length which is 4 days. For this data, there is also no outliers presented.

4.3 Inferential analysis test

This subsection will outline the inferential analysis tests that being conducted for the research project. There were paired sample t-test to test the various objectives and hypotheses. Each section will begin with a brief description of the test used, the outcomes obtained from the test as well as the tabulation of results at the end. All of the tests were analysed by using IBM SPSS Software statistics version 26.

4.3.1 Paired Sample T-test

Paired sample t-test is conducted to find the difference in mean score during early follicular phase and late follicular phase for the same group of participants in two timelines.

4.3.1.1 Paired Sample T-test for Ankle Strength

Table 4.2 Changes in dominant and non-dominant ankle strength of participants in their day 1and day 12 of their menstrual cycle.

	Day 1 (Early follicular phase) Mean ± SD	**Day 12 (Late follicular phase) Mean ± SD**
Plantarflexor, kg		
D	8.6 ± 1.5	8.6 ± 1.5
ND	8.3 ± 1.6	8.3 ± 1.6
Dorsiflexor, kg		
D	6.0 ± 1.3	6.1 ± 1.2
ND	5.7 ± 1.2	5.8 ± 1.2
Plantarflexor Bilateral Assessment (%)	3.6 ± 9.8	3.1 ± 9.5
Dorsiflexor Bilateral Assessment (%)	4.0 ± 11.4	4.0 ± 11.2
CSR (%)		
D	70.7 ± 14.5	70.3 ± 14.0
ND	69.6 ± 10.5	68.9 ± 10.4

Values are presented as mean ± standard deviation. *SD, standard deviation; D, dominant leg; ND, non-dominant leg*

Table 4.2 shows the mean and standard deviation of the ankle strength of the participants during their menstrual cycle day 1 and day 12. For plantarflexor of dominant leg, there was a mean of 8.6 and standard deviation of 1.5 in early follicular phase. During late follicular phase, the mean and standard deviation of plantarflexors' strength of dominant leg slightly increased to 8.7 and 1.5. On the other hand, muscle strength of plantarflexor in non-dominant leg had the mean of 8.3 and standard deviation of 1.6 in the early follicular phase, also having a slight increase of mean and standard deviation in the late follicular phase which

was 8.4 and 1.6. Both dominant leg strength were higher than the non-dominant leg. However, there is no significant differences ($p>0.05$) of muscle strength found between early and late follicular phase (dominant leg, $p=0.174$; non-dominant leg, $p=0.166$).

For dorsiflexor in dominant leg during early follicular phase, the mean and standard deviation is 6.0 and 1.3 while for non-dominant leg, its mean was 5.7 and standard deviation was 1.2. In the late follicular phase, both dominant and non-dominant dorsiflexor strength had a slight increase in the mean and standard deviation to 6.1 and 1.2 as well as 5.8 and 1.2 respectively.

Plantarflexor and dorsiflexor bilateral assessment are being analysed too. For plantarflexor bilateral assessment, it had the mean of 3.6 and the standard deviation of 9.8 in early follicular phase while late follicular phase had the mean of 3.1 and standard deviation of 9.5. Dorsiflexor bilateral assessment was higher than plantarflexors where the means and standard deviations were 4.0 and 11.4 in early follicular phase, 4.0 and 11.2 in late follicular phase. Overall, bilateral assessment of dorsiflexor is higher than plantarflexor.

Besides, conventional strength ratio of dominant and non-dominant leg were being analysed. For dominant leg, its CSR value during early follicular phase with its mean of 70.7 and standard deviation of 14.5 was slightly higher than its CSR in late follicular phase with its mean of 70.3 and standard deviation of 14.0. For non-dominant leg, CSR value in early follicular phase was also

slightly higher than the value in late follicular phase with the value of mean 69.6, standard deviation of 10.5 compare with value of mean 68.9 and standard deviation of 10.4. If compare between dominant and non-dominant leg, value of dominant leg was slightly higher than non-dominant leg.

As a nutshell, ankle strength did not show any significant difference between the early follicular and late follicular phase. Additionally, there were no significant correlations ($p>0.05$) in terms of dominant legs and non-dominant legs.

4.3.1.2 Paired Sample T-test for Dynamic Balance

Table 4.3 Balance score

	Day 1 (Early follicular phase)	Day 12 (Late follicular phase)
Anterior Reach Distance, cm		
D	53.3 ± 6.1	56.1 ± 5.4
ND	53.7 ± 6.2	56.7 ± 5.6
Posteromedial Reach Distance, cm		
D	81.7 ± 8.1	84.4 ± 7.1
ND	82.4 ± 8.6	84.5 ± 6.6
Posterolateral Reach Distance, cm		
D	81.7 ± 6.8	87.0 ± 4.9
ND	82.9 ± 7.6	85.6 ± 6.4
Composite score, %		
D	84.8 ± 7.4	89.0 ± 6.2*
NDCurre	85.3 ± 7.5	88.3 ± 5.5

Values are presented as mean ± standard deviation. *Shows significant difference from the early follicular phase. ($p < 0.05$). *SD, standard deviation; D, dominant leg; ND, non-dominant leg*

Dynamic balance was another variable that being measured in this research. Table 4.3 shows the comparison of dynamic balance during participants' early and late follicular phase, for both dominant and non-dominant foot.

For anterior direction, participants reached 53.3 in early follicular phase and 56.1 in late follicular phase with the standard deviation of 6.1 and 5.4 respectively. On the other hands, mean and standard deviation of the anterior

reach distance of non-dominant foot was 53.7 and 6.2 in early follicular phase and 56.7 and 5.6 in late follicular phase.

For posteromedial direction, participants also reached further in late follicular phase when compare with early follicular phase. For non-dominant foot, mean and standard deviation of the posteromedial reach distance was 82.4 and 8.6 in early follicular phase and 84.5 and 6.6 in late follicular phase.

In posterolateral direction, participants reached a mean of 81.7 and the standard deviation of 6.8 during early follicular phase and a mean of 87.0 and the standard deviation of 4.9 during late follicular phase. For non-dominant foot, mean and standard deviation of the posteromedial reach distance was 82.9 and 7.6 in early follicular phase and 85.6 and 6.4 in late follicular phase.

For the composite score calculated, both dominant and non-dominant leg during early follicular and late follicular phase are having low risk of injury as the final percentage of the composite score were not higher than 80%.

Based on Table 4.2, there is a significant difference of composite score in dominant foot during early follicular phase and late follicular phase ($p<0.05$) with a mean difference of 1.05, t value of -4.08 and a p value of less than 0.01. This difference is thus statistically significant with a 95% confidence of the mean difference being within -6.51 and -2.05. However, there is no significant

difference of composite score in non-dominant foot during early follicular and late follicular phase ($p>0.05$).

CHAPTER 5

DISCUSSION

5.1 Chapter Overview

This chapter will outline the discussion on significant findings from the results sections in accordance with the research objectives, which will follow with the limitation of study, recommendations for future research as well as the conclusion of the research project.

5.2 Discussion

This study compared the different across early and late follicular phase of menstrual cycle on muscle strength and dynamic balance among recreational basketball players. This is to test the hypothesis that there will be an effect of menstruation on athletes' dynamic balance and muscle strength hence might affect their risk of injury during playing basketball. The key discoveries were: (1) there was no significant effect across early follicular phase as well as late follicular phase on participants' muscle strength, (2) dynamic balance of participants decreased during early follicular phase compared to late follicular phase and (3) no association between the muscle strength and dynamic balance.

In this study, effect of variables were being studied within day 1 of menstruation (early follicular phase) and day 12 (late follicular phase) of participants' menstruation where they were also considered as the follicular

phase and ovulation phase in others study. This was due to the reason that during a normal menstrual cycle, a typical cycle lasts from 28 to 32 days, although a 28-day optimal cycle that has ovulation on day 14 is the most common (Fridén et al., 2003; Sella et al. 2021). And within the cycle, it was comprised of three phases including follicular phase that last for 12-14 days with the presence of low to increasing estrogen and progesterone throughout its period, then followed by phase known as ovulation that last for roughly 1 day with the spiking of estrogen level and lastly came with a luteal phase that last for 12-14 days with high oestrogen and progesterone. In another way round, five phases can be categorized where their day 1 to 5 as early follicular, day 6 to 12 as late follicular, day 13 to 15 as ovulation, day 16 to 19 as early luteal, day 20-23 as mid-luteal and day 24-28 as late luteal phase (McNulty et al., 2020).

5.2.1 Effect of menstrual cycle on muscle strength

In this study, the outcome shown that there was no significant effect of menstrual cycle on muscle strength. This finding of this study was similar to other studies which there was no variation or significant impact in muscle strength across different phases of menstrual cycle (Dasa et al., 2021; †cecilia Fridén et al., 2003; Kuehne et al., 2021; Romero-Moraleda et al., 2019). However, the measured instruments be utilized to undergo the muscle strengths tests in earlier studies were differed from this study. In the study done by Dasa et al. (2021) and the team, Maximal Voluntary Isometric Grip Strength (MVIGS) with a handheld dynamometer was used and they found that there was no change in their performance in terms of strength throughout the course of the menstrual cycle. Romero-Moraleda et al. (2019), examine about the fluctuations of muscle performance by applying the knowledge of one repetition maximum (1RM) with half-squat exercise with increasing load intensity during the research. To date, compared to traditional percentage-based loading techniques, the variables assessed in Romero-Moraleda et al. (2019) study have more practical applications for tracking training loads. The similar technique was also applied in another research but Kuehne et al. (2021) and the team were measuring muscle strength of upper extremity, the findings shown that there was no significant interaction of muscle strength across menstrual cycle (menstrual phase, ovulation phase and luteal phases) as well.

Conversely, there are 2 studies reported that the muscle strength was differed across menstruation phases. According to Miyazaki & Maeda (2022), estrogen was considered to have a neuroexcitatory impact and estrogen has been

shown to boost spontaneous activation while decreasing inhibition. Hence, muscle activation will be higher during the ovulation phase and luteal phase where the concentration of estrogen is higher than that in follicular phase. This will cause muscle strength was enhanced during high level of estrogen period. Romero-Moraleda et al. (2019) also reported that there was a positive relationship between the excitability and muscular strength due to the variation in hormones. During late follicular phase, the surged of estradiol concentration was associated with the increase of cortical excitation, but in the other side, during early follicular phase, the concentration of estrogen was low and it was accompanied by cortical inhibition. As a result, a plausible theory was that muscular strength should be enhanced during the late follicular because of the greater excitation. Oppositely, muscular strength should be decreased during early follicular phase due to cortical inhibition.

Therefore, looking into the study by Miyazaki & Maeda (2022), isometric muscle force was accounted to be higher in luteal phase than it was during the ovulation phase. In another study done by dos Santos Andrade et al. (2017) about the effect of menstruation on muscular strength balance in female soccer player, the finding indicated that women's hamstring-to-quadriceps peak torque strength balance ratio was considerably lower during follicular phase than that during luteal phase in non-dominant leg. There was no affect in dominant leg. Due to different result being studied in various studies, the effect of menstrual cycle on muscle strength is still left contradictory as each studies used different techniques in accessing the phases of menstrual cycle.

5.2.2 Effect of menstrual cycle on dynamic balance

In the conducted study, result shown that there was a significant difference of composite score in dominant foot across the early follicular phase and late follicular phase. Dynamic balance was found lower in early follicular phase compared to that in late follicular phase which consisted of high concentration of estrogen. This corroborated another research done by Emami et al. (2018) suggested that the **greater dynamic balance score** was obtained in the direction of posteromedial reach distance **during ovulation** phase than it was during the early follicular phase. This research was using the methodology with current research which was Y-balance test. The only difference was the scoring took from each study. In Emami et al. (2018) study, they were using posteromedial direction instead of three directions used in current study. However, there was an evidence proved that the balance test can be simplified by taking only the posteromedial reached distance as the test score of the participants (Robinson & Gribble, 2008). Emami et al. (2018) also believed that the obtained result was due to the alteration in central nervous system function that brought by the hormones fluctuations during menstrual cycle which would influence the binding of neurotransmitter and disturbing their interactions.

In contrast to current study's result, Lee & Yim (2016) found that there was a significant higher postural sway discovered during ovulation, where level of estrogen rises, compared to follicular phase, the phase with low estradiol concentration. According to Silbernagel et al. (2015), synthesis of collagen would actually be inhibited by estrogen and consequently affects the metabolism of connective tissue. Once the metabolism of connective tissue was being

disturbed by the high concentration of estrogen, collagen synthesis and fibroblast proliferation reduced thus causing poor muscular strength and balance (Lee et al. 2013). Likewise, another research by Khowailed et al. (2021), the higher postural sway rate was noticed in women with ovulation than men and women in menstruation. Same goes to the precious study done by Sung et al. (2018), they were using to explore the postural stability, the higher the overall stability index, the more unstable the participant was. Based on their result, the limits of stabilities in ovulation period was the significant greater when compared to that in menses which mean participants is not balance during ovulation. They were focused on the concentration of hormones during menstruation and also believed that there was an effect of estrogen on the receptors in skeletal muscle which will affect the neuromuscular system in females thus resulting in poor balances (Sung & Kim, 2018). Similar patterns was obtained in the study by Yim et al. (2018), ovulation induced more postural sway on the balance test being carried out than that in follicular phase.

In the other hand, there was another research studied on the influence of premenstrual symptoms on postural balance during menstruation cycle. The outcomes shown that women with premenstrual symptoms had a propensity for more postural sway during the mid-luteal period instead of ovulation and early follicular phase. Thus, further studies also have to emphasize in the effect of premenstrual symptoms towards female's balance during menstruation cycle as well. This is due to the reason that it had been suggested that the menstrual cycle and sports-related injuries in women may be connected (C. Fridén et al., 2003). Lastly, Ericksen and the team found no variations in dynamic postural control or

ankle laxity in response to different phase in menstrual cycle (follicular and luteal phase). They reported that there was no association between hormonal changes during menstruation and dynamic postural control as the Star Excursion Balance Test (SEBT) result shown did not have any significance. Thus, Ericksen et al. encourages researchers not to focus on balance, one of the factor leading to ankle injury. Instead, more research on other factors that contributing to ankle instability as well as consequently reduce dynamic postural control was urged to be conducted.

According to the studies above, most of the studies were explored in the population of young healthy women. However, the current study was examined in the population of recreational basketballers, hence the population of the research could be one of the factors that causing the difference in results. There were also lack of studies on effect of menstruation on dynamic balance towards the population of elite athletes. Due to the various results from various studies, there were still left contradictory on the effect of menstrual cycle on dynamic balance. From all the researches, it could not be denied that sex hormones were affecting the mechanical properties of our muscles, tendons, ligaments and etc that would influence our stability or balance no matter what the population was, for instance men or women that went through different phases of menstruation. Thus, more research on effect of menstruation on dynamic balance need to be conducted in future in the population of recreational and elite athletes in various sports.

Lastly, considering the result of current study stated that recreational basketball players would experience a lower dynamic balance in their follicular phase, which meant that they would have a higher risk of fall during that phase. Therefore, this research would be advantageous for the recreational basketball player to take note of their poor balancing during the follicular phase of menstruation especially during session of playing basketball. Thus, balance exercise can be done during that period to avoid fall and to minimize the risk of lower extremity injuries.

5.3 Limitation of the study

There were a few limitation in this study. First and foremost, self-reported menstrual cycle was used instead of undertaking ovulation testing or basal temperature taking or assessing hormones concentration. Even though the tracking required regular informed from the participants, we did a frequent yet comfortable follow up to communicate with them in order to ensure they do not drop out of the study. Moreover, the technique used in this study was feasible, time- and money-saving substitute for direct hormone assessments in tracking menstrual cycle but resulting in non-accurate data obtained. This is due to the reason that the fluctuation in follicular phase will have a greater variation compared to that in luteal phase. Hence, it is inaccurate to predict the distinct menstrual cycle stages without any hormonal investigations or gynaecological assessment (†cecilia Fridén et al., 2003).

Secondly, the current research was conducted in 1 menstrual cycles only and not under strict hormone-controlled. Unlike earlier researches that demonstrated the association of menstrual cycle with variations in strength and dynamic balance, some of them conducted at least 2 repeated menstrual cycle (†cecilia Fridén et al., 2003). Last but not least, this study was conducted on recreational female basketball players which the result may not applicable for those who are elite athletes as well as sedentary females, a minor variation in strength may be significant (†cecilia Fridén et al., 2003). This was due to the reason that exercise will modifies the amount of circulating ovarian hormones during menstruation, physically fit females could have different strength and

balance status throughout the menstrual cycle compared to that in untrained females.

5.4 Recommendation for future study

As mentioned in the study of McNulty et al. (2020), estrogen and progesterone were the endogenous sex hormones presented in menstrual cycle. The cyclic variations of the hormones forming a biological pattern which known as the menstrual cycle. Therefore, refinements could be done in further studies included taking consideration of the combination of three approaches at testing time in identifying the stages of menstrual cycle. As a suggestion, a combination of calendar-based counting method, taking blood sample and urine sample for identifying the hormone concentration can be utilized in further studies. This will help in improving the quality of the research (de Jonge et al., 2019).

Secondly, further studies may conduct a study for at least more than 1 consecutive menstrual cycle to have a clearer picture of the effect of menstrual cycle on muscular strength and dynamic balance. Moreover, to completely understand the correlation between impact of menstrual cycle, muscle strength and dynamic balance studies in women with various degrees of physical fitness, more research is required in this regard (dos Santos A Ndrade et al., 2017).

5.5 Conclusion

In summary, this study reveals no significant different across early and late follicular phase of menstrual cycle on muscle strength but there was a significant different across early and late follicular phase of menstrual cycle on dynamic balance in dominant leg among recreational basketball players. A numerous of study is needed to conduct to explore more on the effect of menstrual cycle on women muscular strength and balance especially among different level of women population.

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APPENDIX A – ETHICAL APPROVAL FORM

UNIVERSITI TUNKU ABDUL RAHMAN
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Re: U/SERC/224/2022

4 November 2022

Mr Muhammad Noh Zulfikri Bin Mohd Jamali
Head, Department of Physiotherapy
M. Kandiah Faculty of Medicine and Health Sciences
Universiti Tunku Abdul Rahman
Jalan Sungai Long
Bandar Sungai Long
43000 Kajang, Selangor

Dear Mr Muhammad Noh,

Ethical Approval For Research Project/Protocol

We refer to your application for ethical approval for your students' research project from Bachelor of Physiotherapy (Honours) programme enrolled in course UMFD3026. We are pleased to inform you that the application has been approved under Expedited Review.

The details of the research projects are as follows:

No	Research Title	Student's Name	Supervisor's Name	Approval Validity
1.	Knowledge and Attitude Towards Overweight and Obesity Among Physiotherapy and Medical Students: A Cross-Sectional Study	Ching Yung Shan	Mr Muhammad Noh Zulfikri Bin Mohd Jamali	4 November 2022 – 3 November 2023
2.	Effects of Different Gluteal Strengthening Programs on Strength, Pain, Functional Disability and Balance Among University Students with Non-specific Chronic Low Back Pain: A Randomized Controlled Trial	Lee Kah Yi		
3.	Effects on Menstrual Cycle on Dynamic Balance and Muscle Strength Among Recreational Players	Ler Chai Hong		
4.	Knowledge and Awareness Towards Pneumonia Among UTAR Non-Health Sciences Undergraduate Students	Chooi Yan Yee	Pn Nurul Husna Binti Khairuddin	
5.	The Effect of Active Video Games on 6-Minute Walk Test in Overweight and Obese Children	Chin Jay Ven		
6.	Association of Functional Ability of Upper Extremity and Scoliosis Among College Students: A Correlational Study	Sammi Leong Sing Yee	Dr Deepak Thazhakkattu Vasu	
7.	A Correlation Study Between Achilles Tendon Contracture and Posterior Tibial Tendon Dysfunction on Ankle Instability Among Young Adults with Pes Planus	See Wan Ni		
8.	A Correlational Study of the Relationship Between Flat Foot with Anterior Pelvic Tilt and Sacroiliac Joint Dysfunction Among Undergraduate Students	Tan Bee Thong		
9.	Association Between Physical Activity, Learning Style and Academic Performance Among UTAR Health Science Undergraduates	Yeoh Zhe Yi	Ms Kamala a/p Krishnan	

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APPENDIX B – INFORMED CONSENT FORM

EFFECT OF MENSTRUAL CYCLE ON MUSCLE STRENGTH AND DYNAMIC BALANCE AMONG RECREATIONAL BASKETBALL PLAYERS

Information Sheet

Dear participants,

Good day! You are invited to participate in a research project conducted by LER CHAI HONG, a Year 3 Trimester 1 student, currently pursuing Bachelor of Physiotherapy (Hons) in Universiti Tunku Abdul Rahman (UTAR), Sungai Long Campus. The objective of this study is to study the effect of menstrual cycle on dynamic balance and muscle strength among recreational basketball players.

Procedures

If you agree to be in this study, you will be asked to fill in the questionnaire distributed. This questionnaire will consist of 2 parts. Part I will be the demographic data of the participants while Part II will be a questionnaire to evaluate the eligibility to participate in this study.

Length of Participation

The **questionnaire** will take around **5 minutes** to complete. Once the inclusion criteria is met, this study requires the participation of **2 times of visits**. Participants will have to stay for around **10 minutes for each time of visit**.

Risks and Benefits

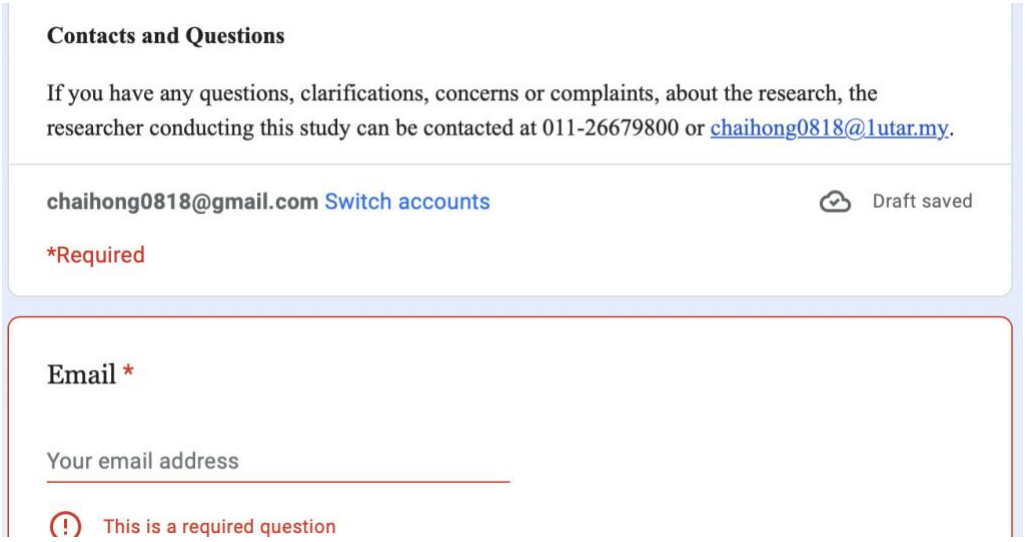
There are no risks or benefits from being in this study. There are also no direct benefits in participating in this study, but the results of the study will help in raising the level of knowledge and good practising procedure in basketball.

Confidentiality

No information that will make it possible to identify you, will be included in any reports to the University or in any publications. Research records will be stored securely and only approved researchers will have access to the records.

Voluntary Nature of the Study

Participation in this study is voluntary. If you withdraw or decline participation, you will not be penalized or lose benefits or services unrelated to the study. If you decide to participate, you may decline to answer any question and may choose to withdraw at any time.


Contacts and Questions
If you have any questions, clarifications, concerns or complaints, about the research, the researcher conducting this study can be contacted at 011-26679800 or chaihong0818@1utar.my.
chaihong0818@gmail.com Switch accounts
Draft saved
*Required
Email *
Your email address
This is a required question

APPENDIX C – PERSONAL DATA PROTECTION NOTICE

Personal Data Protection Statement

Please be informed that in accordance with Personal Data Protection Act 2010 ("PDPA") which came into force on 15 November 2013, Universiti Tunku Abdul Rahman ("UTAR") is hereby bound to make notice and require consent in relation to collection, recording, storage, usage and retention of personal information.

Notice:

1. The purposes for which your personal data may be used are inclusive but not limited to:-

- For assessment of any application to UTAR
- For processing any benefits and services
- For communication purposes
- For advertorial and news
- For general administration and record purposes
- For enhancing the value of education
- For educational and related purposes consequential to UTAR
- For the purpose of our corporate governance
- For consideration as a guarantor for UTAR staff/ student applying for his/her scholarship/study loan

2. Your personal data may be transferred and/or disclosed to third party and/or UTAR collaborative partners including but not limited to the respective and appointed outsourcing agents for purpose of fulfilling our obligations to you in respect of the purposes and all such other purposes that are related to the purposes and also in providing integrated services, maintaining and storing records. Your data may be shared when required by laws and when disclosure is necessary to comply with applicable laws.

3. Any personal information retained by UTAR shall be destroyed and/or deleted in accordance with our retention policy applicable for us in the event such information is no longer required.

4. UTAR is committed in ensuring the confidentiality, protection, security and accuracy of your personal information made available to us and it has been our ongoing strict policy to ensure that your personal information is accurate, complete, not misleading and updated. UTAR would also ensure that your personal data shall not be used for political and commercial purposes.

Consent:

1. By submitting or providing your personal data to UTAR, you had consented and agreed for your personal data to be used in accordance to the terms and conditions in the Notice and our relevant policy.

2. If you do not consent or subsequently withdraw your consent to the processing and disclosure of
your personal data, UTAR will not be able to fulfill our obligations or to contact you or to assist you in
respect of the purposes and/or for any other purposes related to the purpose.

Acknowledgement of Notice *

- (●) I have been notified by you and that I hereby understand, consent and agreed per UTAR above notice
- ( ) I disagree, I do not consent to this study

Name *

Your answer

This is a required question

Electronical Signature *

Electronically s/d nickname or initials
Eg: e*lectronically s/d Ler /// electronically s/d rainbow*

Your answer

This is a required question

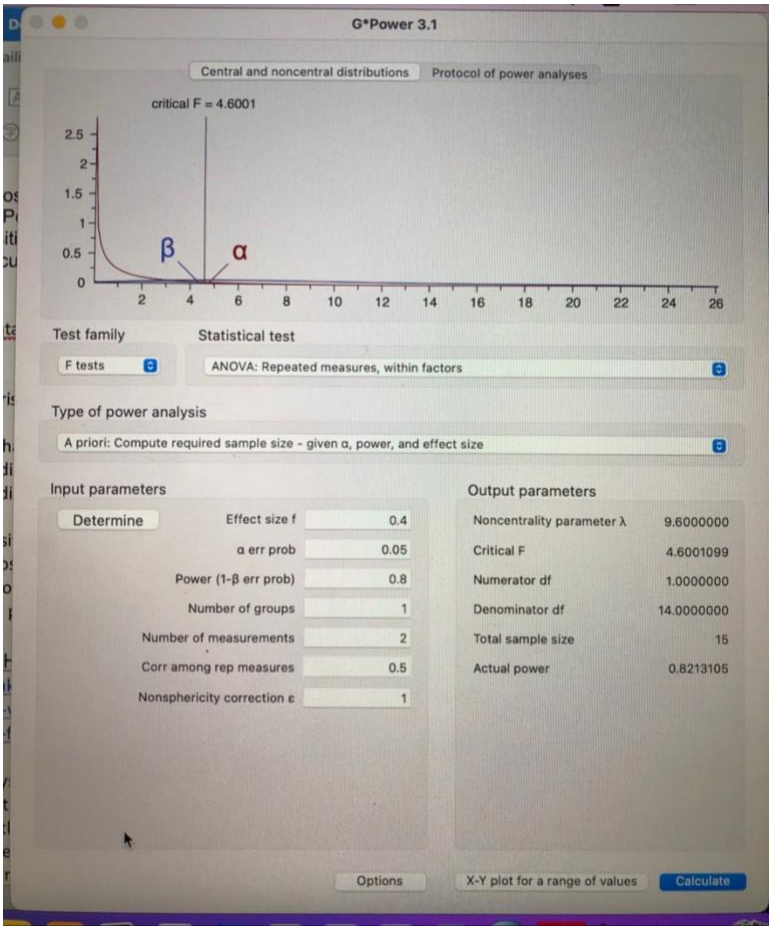
Date of the day *

DD MM YYYY

/ /

This is a required question

APPENDIX D – GPower 3.1 Analysis



APPENDIX E – QUESTIONNAIRE FORM (DEMOGRAPHICS)

Demographic Data

Age *

21

Contact Number *

Eg: 0123456789

0123456789

Height (in cm) *

155

Weight (in kg) *

55

APPENDIX F – SCREENING TOOL

Screening Tools

Are you a basketball player? *

- (●) Yes
- ( ) No

How many days do you play basketball in a week? *

- ( ) 1
- ( ) 2
- ( ) 3
- (●) 4
- ( ) 5
- ( ) 6
- ( ) 7

What is the duration of each playing session? *

Eg: 30 mins or 2 hours

Hr Min Sec

12 : 02 : 02

Do you have menstruation in the past 3 months? *

- (●) Yes
- ( ) No

Please state the first day of your menstruation in **August 2022**. *

Eg: 8/8/2022

de

What are the pre-symptoms of your Aug menstruation? (Emotional symptoms) *

- [ ] Depression
- [ ] Angry outbursts
- [x] Irritability
- [ ] Crying spells
- [ ] Anxiety
- [x] Confusion
- [x] Social withdrawal
- [x] Poor concentration
- [ ] Insomnia

What are the pre-symptoms of your Aug menstruation? (Physical symptoms) *

- [x] Thirst and appetite changes (food cravings)
- [ ] Breast tenderness
- [ ] Bloating and weight gain
- [ ] Headache
- [ ] Swelling of the hands or feet
- [ ] Aches and pains
- [ ] Fatigue
- [ ] Skin problems
- [ ] Gastrointestinal symptoms
- [ ] Abdominal pain
- [ ] Other: _____

Please state the first day of your menstruation in **September 2022**. *

Eg: 8/9/2022

8/9/2022

What are the pre-symptoms of your Sept menstruation? (Emotional symptoms) *

- [x] Depression
- [ ] Angry outbursts
- [ ] Irritability
- [ ] Crying spells
- [ ] Anxiety
- [ ] Confusion
- [ ] Social withdrawal
- [ ] Poor concentration
- [ ] Insomnia
- [ ] Increased nap taking
- [ ] Other: _____

What are the pre-symptoms of your Sept menstruation? (Physical symptoms) *

- [ ] Thirst and appetite changes (food cravings)
- [ ] Breast tenderness
- [ ] Bloating and weight gain
- [ ] Headache
- [ ] Swelling of the hands or feet
- [ ] Aches and pains
- [ ] Fatigue
- [ ] Skin problems
- [ ] Gastrointestinal symptoms
- [ ] Abdominal pain
- [ ] Other: _____

Please state the first day of your menstruation in **October 2022**. *

Eg: 8/10/2022

Your answer

What are the pre-symptoms of your Oct menstruation? (Physical symptoms) *

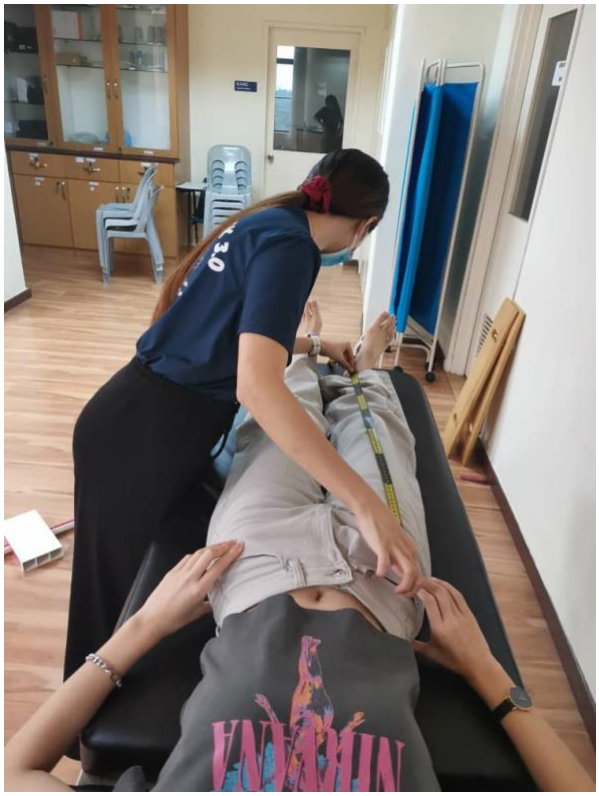
- [ ] Thirst and appetite changes (food cravings)
- [ ] Breast tenderness
- [ ] Bloating and weight gain
- [ ] Headache
- [ ] Swelling of the hands or feet
- [ ] Aches and pains
- [ ] Fatigue
- [ ] Skin problems
- [ ] Gastrointestinal symptoms
- [ ] Abdominal pain
- [ ] Other:

What are the pre-symptoms of your Oct menstruation? (Emotional symptoms) *

- [ ] Depression
- [ ] Angry outbursts
- [ ] Irritability
- [ ] Crying spells
- [ ] Anxiety
- [ ] Confusion
- [ ] Social withdrawal
- [ ] Poor concentration
- [ ] Insomnia
- [ ] Increased nap taking
- [ ] Other:

APPENDIX G – TRUE LIMB LENGTH ASSESSMENT

Left true limb length – from left ASIS to left medial malleolus



Right true limb length – from right ASIS to right medial malleolus

APPENDIX H – Y-BALANCE ASSESSMENT

Left leg, anterior direction

Left leg, posteromedial direction

Left leg, posterolateral direction

Right leg, anterior direction

Right leg, posteromedial direction

Right leg, posterolateral direction

APPENDIX I – TURNITIN REPORT

Effects on Menstrual Cycle on Dynamic Balance and Muscle Strength Among Recreational Players

by Chai Hong Ler

Submission date: 24-Dec-2022 09:32AM (UTC+0800)
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