A SURVEY ON SPORTS ACTIVITY INVOLVEMENT, MENSTRUAL HISTORY AND EATING DISORDERS IN MALAYSIAN FEMALE ATHLETES

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By

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DECLARATION

I hereby declare that this dissertation is the result of my own investigations, except where otherwise stated and duly acknowledged. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at Universiti Sains Malaysia or other institutions. I grant Universiti Sains Malaysia the right to use the dissertation for teaching, research and promotional purposes.

Afiqah Khairunnisa Binti Yunan

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APA	American Psychiatric Association
BMI	Body mass index
DE	Disordered eating
DSM-IV	Diagnostic and Statistical Manual of Mental Disorders
EDE-Q	Eating disorder examination questionnaire
FSH	Follicle stimulating hormone
LH	Luteinizing hormone
OBEs	Objective binge episodes
PMS	Premenstrual syndrome
PCOS	Polycystic ovary syndrome
SBEs	Subjective binge episodes
SD	Standard deviation
STIs	Sexually transmitted infections
±	Plus/minus
cm	Centimetres
kg	Kilogram
%	Percent

TINJAUAN MENGENAI PENGLIBATAN AKTIVITI SUKAN, SEJARAH HAID DAN GANGGUAN PEMAKANAN DALAM KALANGAN ATLET WANITA MALAYSIA

ABSTRAK

Kajian ini mengkaji penglibatan aktiviti sukan, sejarah haid, dan prevalensi gangguan makan dalam kalangan atlet wanita Malaysia. Seramai 50 atlet wanita peringkat kebangsaan dan negeri dengan umur purata 21.16 ± 2.31 tahun mengambil bahagian dalam kajian ini. Mereka terdiri daripada 6 atlet gimnastik, 17 atlet perenang, 5 penunggang basikal, 7 pelari jarak jauh dan 15 atlet silat. Para peserta diminta untuk menjawab soal selidik penglibatan aktiviti sukan, soal selidik sejarah haid, dan soal selidik peperiksaan gangguan makan (EDE-Q). Statistik deskriptif digunakan untuk mengira frekuensi, purata, sisihan piawai dan peratusan. 'Independent t-test' dilakukan untuk membandingkan pemboleh ubah yang diukur antara peserta dengan haid teratur dan tidak teratur. Kajian ini mendapati bahawa seramai 44 daripada 50 keseluruhan peserta (88%) mempunyai haid teratur, sementara 6 peserta daripada 50 keseluruhan peserta (12%) mengalami haid tidak teratur. Bilangan atlet yang mengalami haid tidak teratur adalah 2 orang daripada perenang dan seorang masing-masing daripada gimnastik, berbasikal, lari jarak jauh dan silat. Dalam kalangan semua peserta, usia pada awal latihan adalah 11.60 ± 3.61 tahun. Sementara itu, tempoh latihan keseluruhan adalah 7.96 ± 3.70 tahun. Jumlah jam latihan setiap minggu adalah 20.76 ± 14.44 jam / minggu. Dalam kajian ini, purata kekangan kesemua peserta yang merupakan salah satu subskala EDE-Q adalah 1.48 ± 0.25 (60 hingga 65 peringkat persentil) sementara purata kebimbangan pemakanan semua peserta adalah 1.15 ± 0.40 (75 hingga 80 peringkat persentil). Purata

keprihatinan bentuk bagi semua peserta adalah 2.22 ± 0.49 (55 hingga 60 peringkat persentil) dan purata keprihatinan berat badan bagi semua peserta adalah 2.00 ± 0.52 (60 peringkat persentil). Skor global subskala EDE-Q adalah 1.71 (peringkat 60 hingga 65 peratus) dalam kalangan semua peserta. Perbandingan pemboleh ubah yang diukur antara peserta dengan haid teratur dan haid tidak teratur menunjukkan bahawa usia pada awal latihan lebih muda pada peserta yang mengalami haid tidak teratur (9.83 ± 4.07 tahun) berbanding peserta dengan haid teratur (11.84 ± 3.52 tahun). Jumlah tempoh latihan dalam tahun lebih lama pada peserta dengan haid tidak teratur (8.50 ± 3.33 tahun) berbanding peserta dengan haid teratur (7.89 ± 3.77 tahun). Purata kekangan bagi peserta dengan haid tidak teratur 1.93 ± 0.34 (peringkat 70 – 75 persentil) lebih tinggi daripada peserta dengan haid teratur 1.42 ± 0.26 (peringkat 60 – 65 persentil) dan purata kebimbangan pemakanan melibatkan peserta dengan haid tidak teratur 1.77 ± 0.99 (80 – 85 peringkat persentil) juga lebih tinggi berbanding peserta dengan haid teratur 1.06 ± 0.33 (peringkat 75 – 80 persentil). Purata keperihatinan bentuk bagi peserta dengan haid tidak teratur 3.09 ± 1.02 (peringkat 65 – 70 persentil) lebih besar daripada peserta dengan haid teratur 2.10 ± 0.46 (peringkat 50 – 55 persentil) juga purata keprihatinan berat badan bagi peserta dengan haid tidak teratur 2.50 ± 0.80 (peringkat 65 – 70 persentil) lebih tinggi daripada peserta dengan haid teratur 1.93 ± 0 (peringkat 55 – 60 persentil). Skor global subskala EDE-Q lebih tinggi bagi peserta dengan haid tidak teratur (2.32; peringkat 75 hingga 80 persentil) berbanding peserta dengan haid teratur (1.63; peringkat 60 hingga 65 persentil). Hasil maklumat individu mengenai pemboleh ubah yang diukur peserta yang mengalami haid tidak teratur menunjukkan bahawa perenang peringkat kebangsaan menunjukkan skor global tertinggi daripada skor global subskala EDE-Q, diikuti oleh gimnastik peringkat kebangsaan, atlet silat peringkat negeri, pelari jarak jauh peringkat negeri, perenang peringkat negeri, dan penunggang basikal peringkat negeri. Umur

perenang dan gimnastik yang mula terlibat dalam latihan adalah muda (7 hingga 9 tahun) dan jumlah tempoh latihan dalam tahun adalah panjang (8-14 tahun). Jumlah jam latihan setiap minggu adalah tinggi (12-16 jam / minggu) dalam kalangan perenang dan gimnastik. Sebagai kesimpulan, hasil kajian ini menunjukkan bahawa peserta dengan haid tidak teratur nampaknya mempunyai skor global tinggi subskala EDE-Q, iaitu menahan diri, kebimbangan makan, keperihatinan bentuk dan masalah berat badan. Haid tidak teratur mungkin berkaitan dengan usia awal penglibatan atlet yang muda dalam latihan dan juga tempoh latihan yang panjang dalam beberapa tahun.

A SURVEY ON SPORTS ACTIVITY INVOLVEMENT, MENSTRUAL HISTORY AND EATING DISORDERS IN MALAYSIAN FEMALE ATHLETES

ABSTRACT

This study investigated sports activity involvement, menstrual history, and prevalence of eating disorders among Malaysian female athletes. A total of 50 female national and state levels athletes with mean age of 21.16 ± 2.31 years old participated in this study. They were 6 gymnasts, 17 swimmers, 5 cyclists, 7 long distance runners and 15 silat athletes. The participants were required to answer sports activity involvement questionnaire, menstrual history questionnaire, and Eating Disorder Examination Questionnaire (EDE-Q). Descriptive statistics was used to calculate frequency, mean, standard deviation and percentage. Independent t-test was performed to compare the measured variables between participants with regular and irregular menstruation. The present study found that 44 out of 50 of the total participants (88%) had regular menstruation, while 6 participants out of 50 of the total participants (12%) had irregular menstruation. The number of athletes who had irregular menstruation was 2 individuals in swimming and 1 individual in gymnastic, cycling, long distance running and silat respectively. In all the participants, the age at the beginning of training was 11.60 ± 3.61 years old. Meanwhile, the total training period was 7.96 ± 3.70 years. The total hour of training per week was 20.76 ± 14.44 hours/week. In the present study, the mean restraint that is one of the EDE-Q subscales of all the participants was 1.48 ± 0.25 (60 to 65 percentile rank) while the mean eating concern of all the participants was 1.15 ± 0.40 (75

to 80 percentile rank). The mean shape concern of all the participants was 2.22 ± 0.49 (55 to 60 percentile rank) and the mean weight concern of all the participants was 2.00 ± 0.52 (60 percentile rank). The global score of EDE-Q subscales was 1.71 (60 to 65 percentile rank) in all the participants. Comparisons of measured variables between participants with regular menstruation and irregular menstruation showed that age at the beginning of training was younger in participants with irregular menstruation (9.83 ± 4.07 years old) than participants with regular menstruation (11.84 ± 3.52 years old). The total training period in years was longer in participants with irregular menstruation (8.50 ± 3.33 years) than participants with regular menstruation (7.89 ± 3.77 years). The mean restraint of participants with irregular menstruation 1.93 ± 0.34 (70 to 75 percentile rank) was higher than participants with regular menstruation 1.42 ± 0.26 (60 to 65 percentile rank) and the mean eating concern participants with irregular menstruation 1.77 ± 0.99 (80 to 85 percentile rank) was also higher compared to participants with regular menstruation 1.06 ± 0.33 (75 to 80 percentile rank). The mean shape concern of participants with irregular menstruation 3.09 ± 1.02 (65 to 70 percentile rank) was greater than participants with regular menstruation 2.10 ± 0.46 (50 to 55 percentile rank) also the mean weight concern of participants with irregular menstruation 2.50 ± 0.80 (65 to 70 percentile rank) was higher than participants with regular menstruation 1.93 ± 0.51 (55 to 60 percentile rank). The global score of EDE-Q subscales was higher in participants with irregular menstruation (2.32; 75 to 80 percentile rank) than participants with regular menstruation (1.63; 60 to 65 percentile rank). Individual results of the information on measured variables of participants who had irregular menstruation showed that national level swimmer exhibited the highest global score of the global score of EDE-Q subscales, followed by national level gymnasts, state levels silat athlete, state level long distance runner, state level swimmer, and state level cyclist. The age of swimmers and gymnasts

who started involving in training was young (7 to 9 years old) and the total training period in year was long (8-14 years). The total hour of training per week was high (12-16 hours/week) in swimmers and gymnasts. In conclusion, the present study results implying that participants with irregular menstruation seems to have high global score of EDE-Q subscales, i.e., restrain, eating concern, shape concern and weight concern. Irregular menstruation may be related to young starting age of the athletes involving in training and the long total training period in years.

CHAPTER 1

INTRODUCTION

1.1 Background of the study

The reproductive system of a women displays standard cyclic changes that can be considered teleologically as periodic preparation for pregnancy and fertilization. The process is a menstrual cycle in primate species and human beings, and its most conspicuous feature is the periodic vaginal bleeding that occurs with uterine mucose shedding (menstruation). The duration of the cycle is varies, but the average is 28 days from the beginning of one woman's cycles to the beginning of the next. The days of the cycle are identified by number, beginning with the first days of menstruation. It begins during puberty, tend to range from 10 to 16 years of age, and comes to an end at menopause at a mean age of 51 years (Rosner, 2020).

During women lifetime, females have an estimate of 450 menses; furthermore, because of the risk factors, effects, and pain that it might have, it is necessary for an individual to understand menstrual cycle as well as its physiological functions. To evaluate the factor, a female dealing with primary or secondary amenorrhea will need to pursue clinical examination. Yet, fair monitoring cannot be performed from the level of the ovaries to the hypothalamus unless the hormone feedback mechanism is fully understood by a health professional. There could also be issues with menstrual process itself, such as premenstrual syndrome, dysmenorrhea, or menorrhagia. A clinician must obtain a complete history and physical examination to enable clarification of the root issue without a comprehension of the female anatomy and menstrual cycle physiology (Gunn et al., 2018). It is also generally known that prolonged and strenuous exercise or physical

activities, involvement in leanness-dependent and weight-dependent sports, eating disorders etc. could disturb menstrual cycle of female athletes.

Disordered eating (DE) is described as a constellation of behaviours and attitudes caused by unhealthy consumption and weight, which might have medical and/or psychological implications (Chin et al., 2020). Pengpid & Peltzer (2018) mentioned that in South-East Asia, the prevalence of DE was identified to be growing in lower- and upper-middle-income countries compared with other regions in the world. For comparison, 11.5% of students in South-East Asian nations were recorded as it is at potential for an eating disorder, ranging from below 10 % in Indonesia, Thailand and Vietnam to 13.8% in Malaysia and 20.6% in Myanmar.

DE includes dieting, skipping meals and imbalance eating habits, has been linked with an unhealthy desire for thinness. Consequently, even short- and long-term health hazards, including exhaustion and hormonal disturbances, have been associated with DE, which can lead to menstrual irregularities and reduced bone mineral density (Rock et al., 1996). According to Sundgot-Borgen (2004), prevalence amongst athletes with eating disorders is 13.5% of athletes have eating disorders that are subclinical or clinical. Among athletes, the prevalence of DE is greater than in controls, especially higher in female athletes than in male athletes, and more popular than in other sports for those participating in leanness-dependent and weight-dependent sports.

Quah (2009) revealed in his study that the risk of developing eating disorders, irregular menstrual cycles, and osteoporosis, which are commonly referred to as the ‘female athlete triad’ appears higher for women competing in a wide variety of competitive sports. The goal of this previous research study was to determine the prevalence of the female athlete triad among athletes competing in

various sports and factors associated with this disorder. The research study included a total of 67 elite female athletes aged between 13-30 years and were partitioned into classes of ‘leanness’ and ‘non-leanness.’ The prevalence of respondents at risk of menstrual irregularity, low bone density and eating disorders in the leanness community was 47.6%, 13.3% and 89.2% respectively; and in the non-leanness group, 14.3%, 8.3% and 89.2% (Quah, 2009).

To date, information is still limited on sports activity involvement, menstrual history and eating disorder in Malaysia athletes, therefore the present study was proposed to investigate the sports activity involvement, menstrual background, and prevalence of eating disorder among Malaysian female athletes.

1.2 Objectives of the study

1.2.1 General objective

To investigate sports activity involvement, menstrual history, and prevalence of eating disorder among Malaysian female athletes.

1.2.2 Specific objectives

1. To assess sports activity involvement in Malaysian female athletes
2. To assess menstrual background in Malaysian female athletes.
3. To assess prevalence of eating disorder in Malaysian female athletes.

1.3 Hypotheses of the study

Ho_1: There are no relationships between sports activity involvement, menstrual history and eating disorder among Malaysian female athletes.

H_{A1}: There are relationships between sports activity involvement, menstrual history and eating disorder among Malaysian female athletes.

1.4 Significance of the study

This study was carried to assess sports activity involvement, menstrual background, and prevalence of eating disorders among Malaysian female athletes. It is hoped that the study results could add new information in the field of sports science for female athletes to reduce the occurrence of eating disorder and menstrual disorder.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction of menstrual

The menstrual cycle begins with menstruation, as females bleed and shed the lining of the uterus (unless they have become pregnant). The menstrual cycle's fundamental biology is a complicated, integrated sequence of processes like regulated shredding of the uterine lining involving the hypothalamus, anterior pituitary, ovary, and endometrium. External factors such as stress, excessive exercise, disordered eating, and obesity might well easily disrupt the menstrual cycle with all of its complications (Hawkins & Matzuk, 2008). Periods, associated with low luteinizing hormone (LH), follicle stimulating hormone (FSH), progesterone and constantly increasing oestrogen levels, is the beginning of the follicular process, or 'poor hormonal' phase. The length of this stage was only the first 14 days of the menstrual cycle. Ovulation should indeed occur as part of the cycle, which is indicated by an increase in oestrogen and luteinizing hormone levels. This corresponds with the production of the egg and is the time that females will become pregnant during the menstrual cycle. Ovulation is proceeded by the luteal phase but when both oestrogen and progesterone levels are higher, it is the high-hormone phase of the menstrual cycle (Hawkins & Matzuk, 2008). Basically, normal menstrual is also known as eumenorrhea.

2.1.1 Menstrual disorder

Menstrual cycles sometimes lead to the occurrence of unpleasant symptoms. The most typical symptoms, such as mild cramping and nausea, include premenstrual syndrome (PMS), yet these symptoms generally disappear when menstrual period starts. Apart from that, there are other severe menstrual issues can arise. For instance, too heavy or too light menstruation, or the complete absence of a cycle, indicating that there are other problems that lead to an irregular menstrual cycle.

Amenorrhea is the absent or abnormal stopping of menstruation. Primary and secondary amenorrhea refer to amenorrhea that occurs before and after menarche, respectively. The most of primary and secondary factors of amenorrhea are equivalent. The timing of primary amenorrhea evaluation identifies the pattern against earlier menarche and is thus noted when there has been a malfunction to menstruate by age 15 in the presence of normal secondary sexual development (two standard deviations above the mean of 13 years), or within five years after breast development if that happens prior to age 10 (Herman-Giddens et al., 1997).

'Primary amenorrhoea' has mostly been reinterpreted by the American Society of Reproductive Medicine as the presence of menstrual cycles in a girl who has not started menstruating by 15 years of age, even though she has experienced other natural changes that occur during puberty. Sometime after menarche, the initiation of amenorrhoea is called secondary amenorrhoea. For example, amenorrhoeic women, such as anovulatory women, are infertile without ovulation, but when their oestrogen levels rebound, they increase and can ovulate before menstruating, in other words, before they realize that their fertility is regained. Thus, they should not depend on their amenorrhoea for birth control (Practice Committee of the American Society for Reproductive Medicine, 2004).

Articles of the prevalence of menstrual disorders in athletes differ widely, however findings of the study by Sanborn et al. (1982) support results of previous study of higher incidences in aesthetic, endurance, and weight division sports, and higher volumes of exercise and lower body weights at younger ages. Klentrou (2003) stated that the occurrence of oligomenorrhoea in athletes were as high as 61 percent, around one year after menarche in rhythmic gymnasts.

2.1.2 Effects of menstrual on female athletes

A previous study has shown that about 75 percent of athletes suffer harmful side effects due to menstruation. Cramps, back pain, headaches, and bloating are among the most common side effects (Martin et al., 2018). The distinction in primary sex hormones is one of the features identifying males and females which are oestrogen and progesterone for females while testosterone for males. These hormones are responsible for ensuring a balanced menstrual cycle in females and relating to bone health, and consequently have an impact on performance.

Kin et al. (2000) stated that 54.37 percent of female athletes and 72.73 percent of the control group had irregular menstruation when they analysed 103 athletes and 99 sedentary women between the ages of 12-25, the percentage of the menstrual stage showing pain and no pain is 70.87 percent and 29.3 percent respectively. Besides that, when the female athletes were asked about the impact of the menstrual stage on their performance, they obtained the response of 50.49 percent that does not affect and 49.51 percent which are affected in the same research.

Ozdemir and Kucukoglu (1993) in their study revealed that when women have painless menstrual cycle, their speed and strength are not adversely affected. Besides, in

the sprint test and in the mid-follicular and luteal gathering speed tests performed onto 11 female athletes with normal menstruation, Hazir et al. (2011) were unable to identify any impact of menstruation on repeated sprint performance and gathering speed throughout the mid-follicular and luteal phase tests.

On the other hand, according to Bruinvels et al. (2016), there are more than half of elite women athletes indicated that their exercise fitness and performance potential were negatively influenced by hormonal changes during their menstrual cycle. Research has found changes in intensity, metabolism, inflammation, body temperature, fluid balance and risk of injury that are consequent during the period with hormone imbalances. The context where the menstrual cycle affects women and their performance, is indeed different for everyone and there are no changes throughout the process in a variety of researchers (Oosthuyse & Bosch, 2010).

2.2 Introduction of Eating Disorder

Extreme mental conditions that often occur among female athletes are eating disorders. They are unhealthy eating patterns that can only be diagnosed by strict requirements. While mostly defined as irregular eating behaviour, eating disorder does not include all the requirements for diagnosed eating and is therefore a way of identifying the issue in its early stages (Coelho et al., 2014). Of that kind conditions are defined by major food, weight and shape issues that correspond to impaired eating habits, such as hunger, fasting, sometimes missing meals, overeating, and binge-eating accompanied by purging, as well as the use of dietary supplements, laxatives, diuretics, and even strenuous exercise (Nattiv et al., 2007).

Ron Thompson, PhD, a consultant psychologist at the Indiana University Athletic Department who specializes in the treatment of eating disorders, says that eating disorders exist in all sports with the highest risk of eating disorders are those referred to as 'lean' sports. Generally, we know that lean sports are sports that have a weight-class prerequisite or for which a low body weight or a lean body claimed to have a competitive advantage. For instance, gymnastics, rowing, ballet, cycling and martial arts. Eating disorders frequently tend to evolve more in athletes who play judged sports than referred sports. According to the National Association of Anorexia Nervosa and Associated Disorders, thirteen percent of athletes in judged sports have eating disorders versus three percent in referred sports (Bowers & Sohrabi, 2014).

Disordered eating is more prevalent among athletes than non-athletes, highlighting in the athlete population the relative importance of this topic (Sundgot-Borgen & Torstveit, 2004). Most of the research examine the prevalence in female athletes of disordered eating. Eighteen percent of athletes were diagnosed with an eating disorder in a survey of 522 elite female athletes and 448 non-athlete controls undertaking a disordered eating questionnaire, psychiatric assessment, and interview, compared with just 5 percent of non-athlete controls (Sundgot-Borgen, 1993).

In comparison, relative to the control group, athletes appeared to under-report disordered eating symptoms on questionnaires. Different findings were observed in a similar but larger sample, involving 1620 athletes and 1696 controls, with 20 percent of female athletes meeting eating disorder requirements compared to 9 percent of female controls (Sundgot-Borgen & Torstveit, 2004).

2.2.1 Classification of Eating Disorders among female athletes

2.2.1.1 Anorexia Nervosa

Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) defined anorexia nervosa as a disease in which extreme weight loss is caused by anxiety, compulsive tendencies, and concern for food and diet. Have an overwhelming fear of weight gain, and as a result, food-related problems become intensely emotional-see themselves as overweight when they look in the mirror as indicated by the criteria of DSM-IV. Anorexia nervosa is further categorized into two kinds: restricting type and purging type which is also known as binge-eating. Extreme weight loss from restrictive anorexia nervosa occurs by reducing energy or food intake. This is accomplished by dieting, fasting, and/or excessive exercises. Meanwhile, when anyone that has anorexia nervosa type binge-purge, they also preform recurring binge eating or purging episodes in combination with reducing food intake. This involves acts such as self-induced vomiting, or the use of laxatives, diuretics, or enemas for violence.

When the athletes weigh at least 15 percent less than the average safe weight required for their height, anorexia nervosa is diagnosed (American Psychiatric Association, 2013). There are four key factors explain anorexia as stated by DSM-IV: amenorrhea, intense dread of gaining weight, less than 85 percent of the predicted weight or body mass index (BMI 17.5) and inaccurate understanding of the height, body weight or form of your own body. Disturbance in the manner in which is one's body weight or form is perceived, excessive impact on self-evaluation of body weight or shape, or ignorance of the magnitude of the current low body weight. For example, amenorrhea which is the presence of at least three consecutive menstrual periods in post-menarche females.

2.2.1.2 Bulimia Nervosa

Individuals with bulimia nervosa can be mildly underweight, standard weight, overweight or even obese, and they may often eat and exercise regularly. They are not as underweight as persons with anorexia nervosa. However, the individuals with bulimia nervosa binge eat regularly and can eat and enormous amount of food in a short time, sometimes eating thousands of calories high in sugars, carbohydrates, and fat throughout these periods. Stomach pains and fear of weight gain are common explanations for purging people with bulimia nervosa by throwing up or using a laxative after a binge. This cycle is usually repeated at least many times a week or several times a day in extreme cases (American Psychiatric Association, 2013).

People with anorexia nervosa and bulimia nervosa appear to be poor self-esteem, perfectionists and are highly critical of themselves and their bodies. Generally, they will "feel fat" and see themselves as overweight, often even despite life-threatening semi-death (or malnutrition). An overwhelming fear of gaining weight and being overweight may become widespread. They also dispute that they have a problem in the early stages of these disorders (American Psychiatric Association, 2013).

2.2.1.3 Anorexia Athletica

The concept of anorexia highlighting the subtype anorexia athletica (sports anorexia) also corresponds since hyper gymnasia is an eating disorder marked by an obsession with exercise to lose weight or avoid weight gain. Anorexia athletica is still recognized as a serious problem due to eating disorders such as anorexia nervosa and bulimia nervosa, though perhaps not officially acknowledge by the American Psychiatric Association (APA) as an official eating disorder. Nattiv et al. (2007) note certain hazardous and peculiar behaviours in the female athletic population. The existence of

'anorexia athletica' was the illustration. They can limit the intake of nutrients, but not to the point of being diagnosed with anorexia nervosa. Anorexia athletica can also be seen, despite high physical activity, as a condition of decreased energy consumption and decreased body mass. It has most but not all, eating disorder features and is therefore referred to as a disordered eating disorder or a subclinical eating disorder (Sudi et al., 2004).

2.2.2 Implications of Eating Disorder

Eating disorders may have severe consequences on the health and performance of athletes (Joy et al., 2016).

2.2.2.1 Impact on wellbeing

Extremely concerning is the fact that over-exercise which is commonly among competitive athletes is an abnormal eating behaviour that is most highly correlated with depressive symptoms (Smith et al., 2013). A widely recognized complication is the Female Athlete Triad among female athletes with disordered eating, specifically to those who have restricted dietary intake. Therefore, there are three related factors to different disorders which are defined by the ‘Triad’, such as poor energy supply, menstrual dysfunction, and poor bone mineral density (De Souza et al., 2014). Female athletes can have one or more of the three components of the ‘Triad’, and primary prevention is important to avoid their progression to extreme endpoints, including clinical eating disorders, amenorrhoea, and osteoporosis (De Souza et al., 2014).

Death from heart failure, mostly by those with unusually low body weight. Technically, can cause from electrolyte disorders affected by self-induced vomiting, laxative misuse, and diuretic abuse (Joy et al., 2016). As mentioned by McCallum et al.,

(2006) although the heart effects of eating disorders, particularly anorexia nervosa, are largely attributed to morbidity and mortality. Apart from the health issues, Arcelus (2011) mentioned that it is not easy to identify the precise causes of the death caused by anorexia nervosa.

2.2.2.2 Impact on performance

It has been reported that the exact correlation between eating disorders and athletic performance has not been discovered, although there are some indirect or informal evidence available, such as coach reports and accounts from athletes with eating disorders (El Ghoch et al., 2013). There seems to be some evidence on the impact on sport performance of particular eating disorder characteristics, i.e., being underweight, extreme compulsive exercise, food restriction, binge eating and purging. These kinds of symptoms can also be seen in athletes who might not show the traditional psychopathology of eating disorder but rely on excessive weight management activity, "disordered eating", to enhance their sport performance (Sundgot-Borgen & Torstveit, 2010).

As stated by De Souza et al., (2014), the participation in sport should be categorically confined to female athletes with anorexia nervosa and a body mass index (BMI) < 16.5, also those with bulimia nervosa purging four or multiple times per day. This is due to the fact that insufficient supply of energy lead to the destruction of fat and lean body mass, electrolyte imbalance and malnutrition will result to poor performance in the sport (El Ghoch et al., 2013).

A report of junior elite female swimmers showed that in comparison to cyclic swimmers, those who with energy restriction and hormonal stimulation had low sports results (VanHeest et al., 2014). Others with abnormal eating pattern seem more than twice as likely to experience a musculoskeletal injury throughout their athletic season, amongst most high school athletes (Thein-Nissenbaum et al., 2011).

CHAPTER 3

METHODOLOGY

3.1 Study Design

This was a cross-sectional study with purposive sampling method. Fifty-one Malaysian female state level athletes, i.e., gymnasts, swimmers, cyclists, long distance runners, rower, and martial arts (silat) with age ranged from 18 to 30 years old were recruited. This research aimed to investigate menstrual history and identify eating disorder in the Malaysian female athletes. Thus, the participants were required to answer Sports Activity Involvement, Menstrual History Questionnaire, and Eating Disorder Examination Questionnaire (EDE-Q) through online (Google form) to the participants for data collection. The questionnaires took approximately 15 minutes to complete. Please refer to **Figure 3.1** for the flow chart of the experimental design of the study.

3.2 Sample Size Calculation

Sample size calculation was based on single proportion formula as follow,

$n = (Z/\Delta)^2 (p(1-p))$

n = minimum required sample size

Z = value of standard normal distribution = 1.96 for 95% CI

Δ = precision

P = True proportion

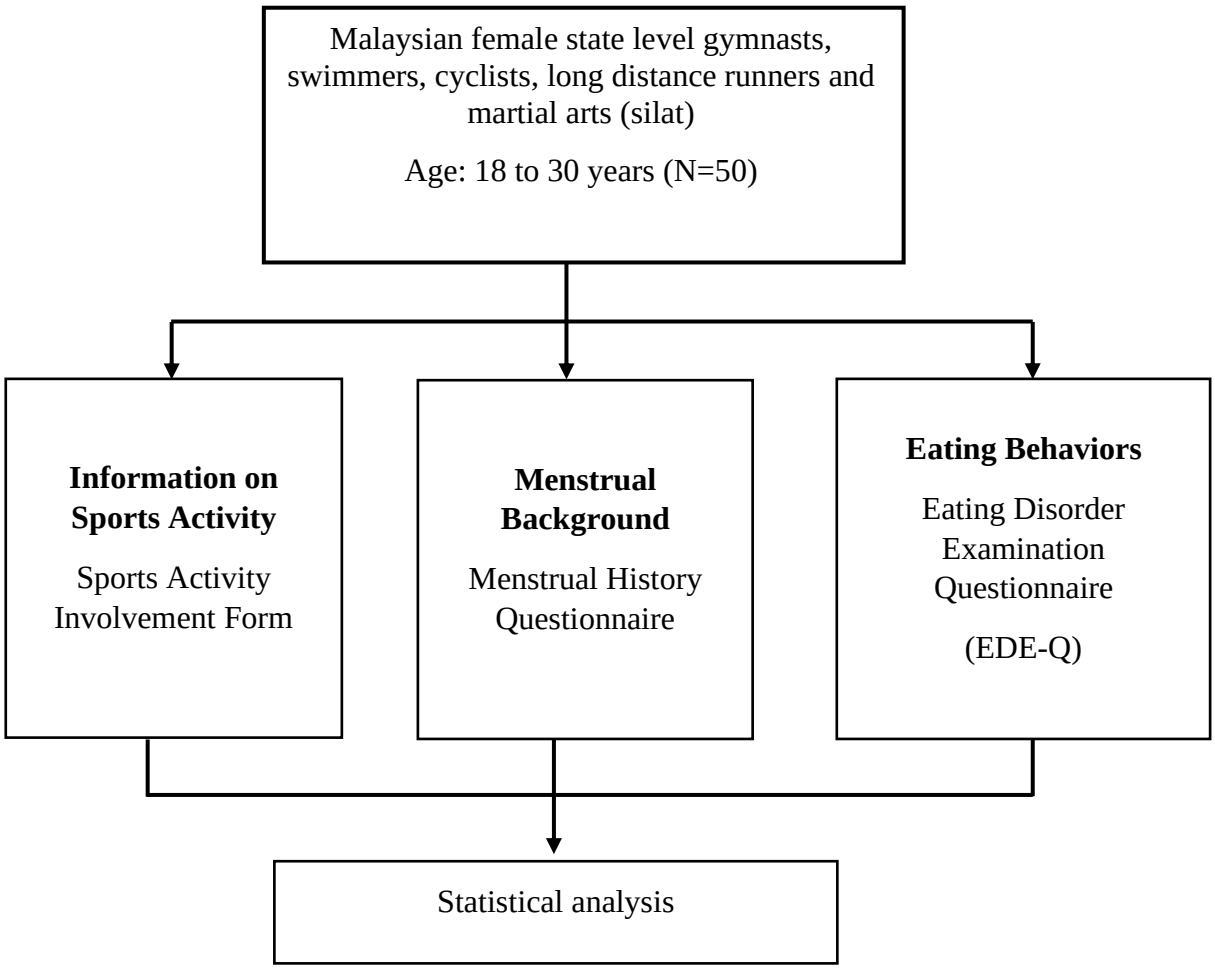

Figure 3.1 Flow chart of the experimental design of the study

Based on the prior research by Hashim et al. (2019), the participants involved were 8710 people and 95% female participants were reported to have at least one premenstrual syndrome (PMS) during their menstrual period. The sample size of the previous study was n=300. Participants who were pregnant and with history of chronic diseases such as sickle cell anaemia, diabetes etc, or any psychiatric disorders, irregular menstrual cycles, and age younger than 18 or older than 24 years old were excluded from the analysis. Taking the precision of 0.05 at 95% of confidence interval (CI), the sample size was needed for this study was 45 participants. However, 50 participants were recruited after taking into account of 10% drop out rate.

3.3 Participants' Recruitment and Selection Criteria

Fifty-one participants who were Malaysian female state level gymnasts, swimmers, cyclists, long distance runners, and martial arts (silat) with age ranged between 18 to 30 years old were recruited in this study. Athletes in these few sports events were recruited based on the fact that athletes involved in these few sports tended to have high risks of eating disorder and menstrual disorders. The athletes were recruited via WhatsApp messages with information of the current research study through the contact of coaches. The participants were volunteer to join this study and no compulsion if they have any obstruction. Participants were provided consent forms and who met the inclusion requirements and agreed to participate in this study have provided their consensus in the consent forms.

The inclusion criteria of the participants were Malaysian females aged between 18 to 30 years old, who had either involved in the sports of gymnastics, swimming, cycling, long distance running, rowing, and martial arts (silat) for at least two years, and

representing the respective sport events at least at state level in competitions. Participants who did not fulfil the inclusion criteria were not recruited in this study.

The participants were given a Research Information sheet (Lampiran A and Attachment B) (please refer Appendix B) and briefed details of the study design including inclusion and exclusion criteria, termination or withdrawal, potential risks, and benefits. If they agreed to participate, they were required to fill in the Participant's Information and Consent form. After that, participants were screened in order to determine the inclusion and exclusion criteria were met.

Involvement as participants in this study was on voluntary basis. Thus, participants had the right to withdraw themselves from this study at any time during the study period. Their decision to withdraw would be accepted without any prejudice. Data was collected via online google form. Any of the information gathered for this research would be kept strictly confidentiality. Participants would not be required to include any detail that could be used to identify them. Participants could only include their email addresses to prevent duplication and to allow for responses. Their participation could also be terminated if they did not complete any or all the questionnaires.

Regarding the benefits obtained from this study, participants would get to know their menstrual status and status of eating behavior, getting more insight and scientific knowledge in the field of sport science.

3.4 Data Collection

3.4.1 Sports Activity Involvement

All the participants were required to answer sports activity involvement form (Please refer to Appendix F). The questions included type of sports involved, level of sports participation, age at the beginning of training, total training period in years, total hour of training per day, number of training session per week and total hour of training per week.

3.4.2 Menstrual History Questionnaire

All the participants were required to answer the menstrual history questionnaire (Please refer to Appendix G). The menstrual history questionnaire was used to analyse the menstrual status of participants. The questionnaire consisted of questions such as age of first menstruation (age at menarche), the date of last menstrual period if the participant has irregular period, the age of menstrual period stops and the average duration, i.e., length of the menstrual cycle. The menstrual history questionnaire was featured in the prior conducted research by Galuska and Sowers (1999).

3.4.3 Eating Disorder Examination Questionnaire (EDE-Q)

In this study, all the participants were required to answer the eating disorder examination questionnaire (EDE-Q) (Please refer to Appendix H). The eating disorder test (EDE) is a semi-structured assessment used internationally for clinical techniques and for the determination of the primary psychopathology of the eating disorder. The eating disorder examination questionnaire (EDE-Q) was designed as a self-reported survey variant of the full-length interview (Rø et al., 2010). The EDE-Q has strong test

reliability, correlation with the EDE survey and good success in group studies (Mond et al., 2007).

The eating disorder examination questionnaire (EDE-Q) (Mond et al., 2007) assesses the frequency of objective binge episode (OBEs; defined as feeling a loss of control while eating unusually large quantities of food; this definition corresponds to the DSM-V criteria for binge eating), subjective binge episodes (SBEs; defined as feeling a loss of control while eating, but without eating unusually large quantities of food, inappropriate weight control and purging methods over the past 28 days, it comprises four subscales (Restraint, Eating Concern, Weight Concern and Shape Concern) and a Global total score.

3.5 Statistical Analysis

All statistical analysis was carried out using Statistical Package for Social Sciences SPSS) version 26. Descriptive statistics using numerical method to calculate the mean, standard deviation, and percentage. Meanwhile, create frequency tables by using graphical method. Independent t-test was used to compare the measured parameters between group of participants with regular and irregular menstruation The results are presented as means and standard deviation; mean ± SD. The acceptance level of significance was set at $p<0.05$.

CHAPTER 4

RESULTS

4.1 Physical characteristics and body composition

A total of 50 Malaysian participants, i.e., 6 gymnasts, 17 swimmers, 5 cyclists, 7 long distance runners and 15 silat athletes completed the present study. The mean age of all the participants was 21.16 ± 2.31 years old (range from 18 years old to 28 years old). Table 4.1 illustrates the mean age, body height, body weight and body mass index (BMI) of all the participants in this study.

Table 4.1: Mean age, body height, body weight and body mass index (BMI) of all the participants

Parameters	Mean ± SD
Age (years)	21.16 ± 2.31
Body weight (kg)	52.79 ± 7.63
Body height (cm)	158.71 ± 7.03
Body Mass Index (BMI)($kg.m^{-2}$)	20.90 ± 2.25

4.2 Sports activity involvement

Table 4.2(a) illustrates the sports activity involvement of all the participants, such as type of sports involved and their level of participation in competition. There were 6 gymnasts, 17 swimmers, 5 cyclists, 7 long distance runners and 15 silat athletes. In terms of level of sports participation, 24 athletes represented Malaysia at national level, 26 athletes represented state at state level. In details, all six of the gymnasts' athletes represented Malaysia at national level, while 6 out of 17 swimming athletes represented Malaysia at national level. Four cyclists represented Malaysia at national level and 1 cyclist represented state at state level. Meanwhile, 2 out of 7 long distance runner athletes represented Malaysia at national level. Six out of 15 silat athletes represented Malaysia at national level.

Table 4.2(b) tabulated information about the age at the beginning of training, total training period in years, total hour of training per day, number of training session per week and total hour of training per week of all the participants.

Table 4.2(a): Types of sports involved and their level of participation in competition of all the participants

Types of sports involved		Level of participation in competition	
		National level	State level
1	Swimmers	6	11
2	Silat athletes	6	9
3	Long distance runners	2	5
4	Gymnasts	6	0
5	Cyclists	4	1
Total participants: 50		24	26

Table 4.2(b): Means of age at the beginning of training, total training period in years, total hour of training per day, number of training session per week and total hour of training per week of all the participants

	Mean ± SD
Age at the beginning of training (years old)	11.60 ± 3.61
Total training period in years (years)	7.96 ± 3.70
Total hour of training per day (hours/day)	3.48 ± 1.90
Number of training session per week (session/week)	6.64 ± 3.26
Total hour of training per week (hours/week)	20.76 ± 14.44

4.3 Menstrual history

Regarding age at menarche, none of the participants had first menstruation young than 10 years old, 26 of the participants had first menstruation between 10 to 12 years old, 22 of the participants had first menstruation between 13 to 15 years old, and 2 of the participants had first menstruation between 16 years old or older.

It was found that 44 out of 50 of the total participants (88%) had regular menstruation, while 6 participants out of 50 of the total participants (12%) had irregular menstruation. The number of athletes who had irregular menstruation was 2 in swimming, 1 in gymnastic, cycling, long distance running and silat respectively.

The average duration of menses of all the participants was 6.68 ± 1.61 days. The average length of the menstrual cycle of all the participants was 24.28 ± 8.66 days.

4.4 Eating disorders

Table 4.4 illustrates results of four subscales (restraint, eating concern, weight concern and shape concern) and the global total score of Eating Disorder Examination-Questionnaire (EDE-Q) of all the participants. The global score of EDE-Q subscales was 1.71 (60 to 65 percentile rank) in all the participants.

Table 4.4 Eating Disorder Examination-Questionnaire (EDE-Q) subscales of all the participants

EDE-Q subscales	Question	Category	Mean ± SD
Restraint	1	Restraint overeating	1.48 ± 0.25 (60 to 65 percentile rank)
	2	Avoidance overeating	
	3	Food avoidance	
	4	Dietary rules	
	5	Empty stomach	
Eating concern	7	Preoccupation with food, eating or calories	1.15 ± 0.40 (75 to 80 percentile rank)
	9	Fear of losing control overeating	
	19	Eating in secret	
	21	Social eating	
	20	Guilt about eating	
Shape concern	6	Flat stomach	2.22 ± 0.49 (55 to 60 percentile rank)
	8	Preoccupation with shape or weight	
	23	Importance of shape	
	10	Fear of weight gain	
	26	Dissatisfaction with shape	
	27	Discomfort seeing body	
	28	Avoidance of exposure	
	11	Feelings of fatness	
Weight concern	22	Importance of weight	2.00 ± 0.52 (60 percentile rank)
	24	Reaction to prescribed weighing	
	8	Preoccupation with shape or weight	
	25	Dissatisfaction with weight	
	12	Desire to lose weight	
Global scale			1.71 (60 – 65 percentile rank)

4.5 Comparisons of measured variables between participants with regular menstruation and irregular menstruation

Table 4.5(a) illustrates results of age, body height, body weight and body mass index (BMI) of the participants with regular menstruation irregular menstruation. Table 4.5(b) highlights results of age at the beginning of training, total training period in years, total hour of training per day, number of training session per week and total hour of training per week of participants with regular menstruation and irregular menstruation. Meanwhile, Table 4.5(c) illustrates results of Eating Disorder Examination-Questionnaire (EDE-Q) subscales of the participants with regular menstruation and irregular menstruation. Moreover, Eating Disorder Examination-Questionnaire (EDE-Q) subscales of the participants with regular menstruation and irregular menstruation are shown in Figure 4.5.

Table 4.5(a) Means of age, body height, body weight and body mass index (BMI) of the participants with regular menstruation irregular menstruation

Variables	Participants with regular menstruation (n=44)	Participants with irregular menstruation (n=6)
Age (years)	21.27 ± 2.30	20.33 ± 2.42
Body weight (kg)	52.80 ± 7.99	52.75 ± 4.64
Body height (cm)	158.76 ± 7.04	158.33 ± 7.58
Body Mass Index (BMI)($kg.m^{-2}$)	20.89 ± 2.37	21.03 ± 1.03