

Awareness of the Female Athlete Triad in Female Athletes

Manasi Desai and Raote Prajal

Abstract

Aim: Female athlete triad is characterized by prevalence of 3 components - low energy availability with or without an eating disorder, menstrual dysfunction and low bone mineral density in physically active females. **Method:** A survey-based cross-sectional study was conducted on 101 female athletes from Mumbai. A self-designed questionnaire aimed at getting information regarding the awareness of triad along with their demographic details. **Results:** The study reveals 49.5% were unaware of the Female Athlete Triad, 15.84% were unsure about it and only 34.65% were known to the term. Only 24.75% were able to identify all the three components of the triad. **Conclusion:** Awareness about the female athlete triad is low amongst women. Thus a need for awareness generation programs to educate female athletes about the triad is necessary for prevention and early diagnosis.

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Key Words: Female athlete, Triad, Menstrual Dysfunction, Low Energy Availability, Low Bone Mineral Density

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Introduction

Athletics has become a very popular activity and more and more females are participating in athletics over the past four decades as a result of Title IX, the federal law enacted in 1972, that eliminates discrimination based on sex with regard to participation in educational activities (including sports) that receive federal financial support (US Department of Labor, 1972). Along with many benefits of this act, it may cause some female athletes to develop lifelong health problems. Three of the common health problems related to increased physical activity in females include disordered eating, amenorrhea, and osteoporosis (Thein et al., 2011 ; Otis et al., 1997). The American College of Sports Medicine (ACSM) has termed these three disorders as the female athlete triad (Thein et al., 2011). The female athlete triad is a syndrome in which the female athletes present with three interrelated components: disordered eating, amenorrhea, and osteoporosis (Thein et al., 2011 ; Otis et al., 1997). This condition is now considered to be a spectrum disorder, characterized by a dysfunction in energy availability (with or without disordered eating), menstrual function, and bone mineral density (BMD). Low energy stores, increases the risk for an athlete to develop the remaining components of the triad (Barrack et al., 2014 ; Nattiv et al., 2007).

Components of the Triad

Energy Availability- It is necessary to have an optimal nutrition to fuel the physical activity and to maximize performance and recovery. However, to excel at their sport or to achieve a lean physique female athletes may intentionally or unintentionally restrict their caloric intake or over-train, which may result in an energy deficit which puts these female athletes at risk of developing the female athlete triad. Originally, this component was known as “disordered eating.” The spectrum of energy availability ranges from optimal to low. It’s not necessary for an athlete to be diagnosed with an eating disorder to have this component of the triad (Nattiv et al., 2007). Low energy availability can result from inadequate caloric intake caused by conditions like anorexia nervosa or bulimia nervosa or by expending more energy than the body is designed for at a given time. If the BMI is < 17.5 kg/m², it is likely that the athlete has low energy stores (De Souza et al., 2014). Low energy availability is determined to be <45 kcal/kg of lean-body mass per day. However, energy availability <30kcal/kg of lean-body mass causes negative effects (Barrack et al., 2014 ; De Souza et al., 2014; Hoch et al., 2009). Adequate nutrition education among athletes is thus necessary. It should be noted that athletes who are overweight can also be energy deficient. Athletes suffering from disordered eating are at higher risk of low energy availability (Thein et al., 2011).

Menstrual Dysfunction- The spectrum of menstrual function ranges from menstruation every 28 days to amenorrhea (Barrack et al., 2014). Amenorrhea can be primary i.e. absence of menarche after age 15 and secondary i.e. the cessation of menses for three consecutive cycles after menarche. Functional hypothalamic amenorrhea (FHA) associated with the female athlete triad results from an unpredictable release of gonadotropin-releasing hormone (GnRH). Prolonged exertion and weight loss have been shown to influence GnRH release, although the pathophysiology is not entirely clear. GnRH directly affects the release of luteinizing hormone and follicle-stimulating hormone from the pituitary gland. When this pathway is disrupted, it directly affects the release of estrogen from the ovaries, causing FHA (Practice Committee of the American Society for Reproductive Medicine 2004 ; Falsetti et al., 2002). If an athlete has amenorrhea, regardless whether it is primary or secondary, it is prudent to exclude causes other than FHA, including thyroid abnormalities, structural anomalies, pregnancy, polycystic ovary syndrome, and pituitary tumor (Practice Committee of the American Society for Reproductive Medicine 2004). Oligomenorrhea, menstruation every 35 days or fewer than nine menstrual cycles in 1 year, is considered abnormal. A female athlete with any of these menstrual should be assessed for other components of the triad. Estrogen plays an important and complicated role in the physiology of BMD and bone formation. In an estrogen-deficient state, BMD is decreased, thus leading to an increased risk of fragility fracture (Syed and Khosla 2005).

Bone Mineral Density (BMD) - The spectrum of BMD includes osteoporosis but also encompasses reduced BMD because of its role in increased risk of injury in female athletes with the female athlete triad (Nattiv et al., 2007). Younger female athletes must understand that for most women, 90% of peak BMD is reached by age 18 years and that the greatest level of accrual is between the ages of 11 and 14 years (Matkovic et al., 1994). To obtain optimal BMD, adequate nutrition (i.e. protein, calcium, and vitamin D consumption, moderate physical activity with weight-bearing exercise) is required (De Souza et al., 2014 ; Anderson et al., 1993). After the peak BMD has been reached, it may only be lost or maintained (Anderson et al., 1993). It is crucial that athletes possess this knowledge so that they can build and maintain BMD during these years to optimize bone health. Thus, education and awareness of athletes with regard to proper nutrition, menstrual function, low BMD, and the syndrome as a whole is needed to help prevent the manifestation of the triad in female athletes and reduce its prevalence. Education of athletes is crucial for prevention, early identification and appropriate management of the triad. A review of literature reveals that the awareness of the triad in female athletes of India has not been studied. Female athletes in India at a

greater extent may suffer from additional problems like lack of family support, unavailability of proper infrastructure required for a given sport, incomplete knowledge, lack of nutrition and awareness, etc. This further may lead to ignorance of the symptoms and early identification of the triad. Thus, it is a need of the hour to study the awareness of triad among the Female Athletes in India.

Materials and Method

A survey based cross sectional study was conducted in a six month period through a prospective study approach on 101 female athletes recruited from various sports academies in Mumbai. The subjects were aged more than 15 years who were engaged in a high intensity sport and had no past history of any musculoskeletal or neurological or metabolic problem. The nature and purpose of study was explained and prior consent was obtained from the participants. A self-made questionnaire was administered in order to assess the awareness of the female athlete triad after obtaining their demographic data. The study was approved by the Institutional Ethics and Research Committee at D.Y. Patil School of Physiotherapy. Subjects who were willing to participate in the study were recruited for the same. They were assured that the information regarding their identity obtained during the study would be strictly kept confidential. The demographic details including name, age, sport played, experience in the sport, level at which the sport is played, etc. were obtained. A study was conducted by administering a self-designed questionnaire aimed at getting information regarding the awareness of the female athlete triad among female athletes. One hundred one (N=101) female athletes participated in this study.

Results

Among the 101 athletes who participated in this study, all were females. The athletes' mean age was 19.23 ± 2.7 years (Figure 1). Table 1 and Figure 1 shows that the maximum participation of 67.33%, was from the age group of 15-20 years. The mean years of the athlete's involvement (i.e. playing experience) in their respective sport are 5.12 ± 1.47 years (Figure 2). Table 2 and Figure 2 shows that maximum participants (58.41%) were experienced for 1-5 years in the sport they were played. Out of all the subjects competing at various levels, 28.71% played at zonal level, 23.76% at national level, 20.79% at state level, 15.84% at district level, whereas 6.93% played at local tournaments and 3.96% at the international level (Figure 3 and Table 3). The maximum participants (28.71%) were played at Zonal level (Figure 3 and Table 3). Out of the total 101 participants only 34.65% were aware of the term Female Athlete Triad while the other 49.5% were unaware of the term and 15.84% were not sure about it. While only 24.75% could correctly identify all the components of the triad. Thus, the maximum participants (49%) weren't aware of the Female Athlete Triad (Figure 4 and Table 4). Only 24.75% identified all the three components of the triad (Figure 5 and Table 5). When asked to link the components of the triad with physical activity, 46.53% linked it with low BMD, 39.73% linked it with low energy availability and 36.63% linked it with menstrual dysfunction. Participants were the least aware of low energy availability being a component of the triad (Figure 6 and Table 6).

Knowledge about symptoms of low BMD: When asked about their knowledge regarding the symptoms of low BMD, most of the subjects were unaware of Delayed wound healing as a symptom of low BMD followed by other symptoms such as stress fractures, sudden increase in fatigue, consistent body pain, calcium deficiency, recurrent fractures and unexplained pain in the joints. Participants were the least aware of delayed wound healing as a symptom of Low BMD (Figure 7 and Table 7).

Knowledge about symptoms of low energy availability: Out of 101 participants most of them were unaware about induced vomiting as a symptom of low energy availability and followed by usage of diet pills for weight control, body stigma, binge eating habits, pattern of excessive exercise, keeping a strict calorie count, fear of weight gain and purposeful elimination of a certain food item.

Participants were the least aware of induced vomiting as a symptom of low energy availability. (Figure 8 and Table 8).

Knowledge about symptoms of Menstrual Dysfunction: Among all the 101 subjects the least awareness was about primary amenorrhea being a symptom, followed by secondary amenorrhea, oligomenorrhea, orthostatic hypotension and psychological issues (Figure 9 and Table 9).

Discussion

The purpose of this study was to find out the awareness of the female athlete triad among female athletes playing various high intensity sports, namely - Cricket, basketball, football, hockey, kabaddi, kho-kho, throwball volleyball, athletics, gymnastics, powerlifting, taekwondo, badminton, lawn- tennis, table tennis and squash. The study was based on the data collection done through a self prepared questionnaire, on a one to one interview basis.

Awareness estimate of the triad and its components- The primary objective of this study was to assess the awareness of the Female Athlete Triad and to identify the area with the least awareness. Out of the 101 athletes in the sample, 49.5% were unaware of the Female Athlete Triad, 34.65% were known to the term, and 15.84% said they were not sure about it (Figure 4). When the subjects were asked to identify the components of the triad in athletes, only 24.75% could correctly identify all three components of the triad (Figure 5). According to Rennolds et al., (2015) in the United Kingdom, 46% were unaware about the triad. Thus, the awareness is lower in India as compared to the United Kingdoms. This may be due to the differences in the population characteristics of both the studies. The study conducted in the UK had evaluated subjects among which some athletes had taken nutrition courses while the subjects of our study were mostly students of higher secondary schools. In addition to this, athletes in India especially female athletes face various socio-ecological issues. In particular, studies identified the absence of a cultural norm around participation for women and girls, family priorities which focus on studies and supporting the household, lack of infrastructure and programming targeting females (Burton 2015). In considering infrastructure facilities it refers to the non-availability of an area for training halls, indoor stadiums or a constructed play environment to undergo training. Lack of non-availability of qualified coaches results not to produce better performance and they only become the cause of sports injuries (Bhatia 2000). Certain studies show that this lack of knowledge about the female athlete triad and the three components has also been shown among collegiate coaches. In a study conducted by Pantano (2006) in high schools in the UK, only 43% of 91 collegiate coaches were able to identify the three components of the female athlete triad even though 64% answered “yes” to having heard of it. Although, the UK being a developed nation, the level of awareness in coaches was low. Therefore, it can be expected that the awareness in India, which is still a developing nation might be even lower. This further contributes to the results of low awareness regarding the triad in this study. All these above-mentioned constraints that cause reduced awareness of the triad further may cause a delay in diagnosis of this disorder which may interfere with the treatment of the disorder leaving long term ill effects.

The second objective of this study was to identify the component with least amount of awareness. This study found low BMD has the most aware component followed by low energy availability and the least being menstrual dysfunction (Figure 6).

Low BMD- According to the results of the present study 46.53% were able to identify Low BMD as the component of the triad. When asked about their knowledge regarding the symptoms of low BMD, most of the subjects were unaware of Delayed wound healing followed by other symptoms such as stress fractures, sudden increase in fatigue, consistent body pain, calcium deficiency, recurrent fractures and unexplained pain in the joints (Figure 7). A decrease in bone mineral density of an athlete may cause problems like early osteoporosis, increased incidence of injury thus hampering the athletic performance (Zhongguo 2000). While 35% subjects identified it as a

component in a study performed by Rennolds et al., (2015), in the UK shows that in the present study, the awareness regarding low BMD is higher.

Energy Availability-It was found in the present study that 39.73% were able to identify low energy availability as the component of the triad. When the subjects were further evaluated about their awareness on energy availability as a component of the Female Athlete Triad, the results shows that most of them were unaware about induced vomiting followed by usage of diet pills for weight control, body stigma, binge eating habits, pattern of excessive exercise, keeping a strict calorie count, fear of weight gain and purposeful elimination of a certain food item (Figure 8). Negative health consequences of Eating Disorders (EDs) are numerous, as every body system can be affected. This in turn may affect the sport performance of the athletes. Physical consequences of EDs can include delayed puberty, bone growth retardation, and decreased bone deposition. There are also psychological consequences, including depression, anxiety, and suicide (Mountjoy et al., 2015 ; Melin et al., 2014). 71% subjects identified low energy availability as a component in a study performed by Rennolds et al.,(2015) in the UK. This is higher than that of our study and maybe because of the fact the study performed in the UK included many athletes that have taken a course on nutrition in the past.

Menstrual Dysfunction-According to the results of the present study, 36.63% were able to identify menstrual dysfunction as the component of the triad. On further evaluation, it was found that the subjects were the least aware of primary amenorrhea being a symptom, followed by secondary amenorrhea, oligomenorrhea, orthostatic hypotension and psychological issues (Figure 9). The 69% subjects identified menstrual dysfunction as a component in a study performed by Rennolds et al., (2015) in the UK. This is significantly higher than that of the present study. This may be because of the fact that in Indian cultural setup menstruation is mostly considered as a taboo which makes it difficult for the females to discuss their problems regarding menses. A survey in India reported that 87% of the women and girls are completely unaware about menstruation and do not have any knowledge about the purpose of menstruation as a biological process (Sharma et al., 2018). Miller et al., (2012) surveyed 180 female exercisers and found that only 35% of female exercisers viewed irregular periods as a normal occurrence in active females. This justifies the finding of least awareness regarding menstrual dysfunction in our study. Thus an overall lack of awareness of menstrual dysfunction, diminished bone health, and inadequate energy availability due to disordered eating behaviors was observed among female athletes. The three components of the triad are interconnected and aggravate one another taking a cyclic nature. These three conditions may exist predominantly among female athletes due to the situations that make exercise induced physiological adaptations even worse, such as over training and dieting along with lack of awareness of the triad and its components (Simpson et al., 1998). Thus, it is essential that the awareness increases, resulting in prevention and reducing the prevalence of the triad so that benefits of exercise continue to outweigh the risks in female athletes.

Conclusion

1. The results of the present study identify a low awareness of Female Athlete Triad among female athletes. It was found that 49.5% subjects were unaware while 15.89% subjects were not sure about the triad. Thus, indicating only 34.65% awareness.
2. Among all the three components of the triad, the athletes were least aware about menstrual dysfunction, followed by low energy availability and then low bone mineral density.
3. The study shows that among the symptoms of menstrual dysfunction, athletes were least aware about primary amenorrhea.
4. The study shows that among the symptoms of low energy availability, athletes were mostly unaware about induced vomiting.

5. The study shows that among the symptoms of low BMD most athletes were not mostly aware about delayed wound healing as a symptom.

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Table1. Age Group of Participants

| Age Group | 15-20 | 21-25 | 25-30 |
|----------------|-------------------|-------|-------|
| Percentage (%) | 67.33 | 30.69 | 1.98 |
| Mean±SD | 19.23 ± 2.7 years | | |

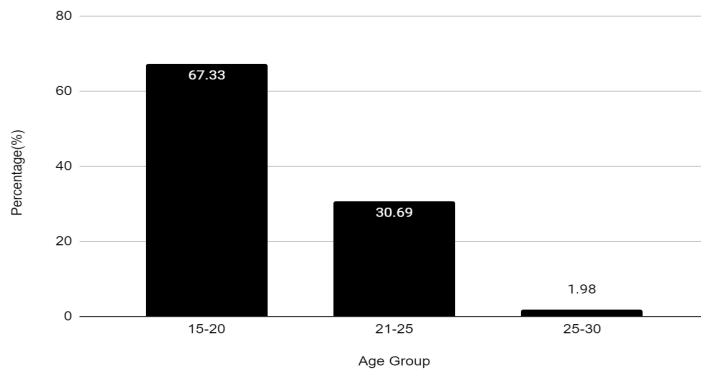


Figure 1. Age Group of Participants

Table 2. Years of Experience of the Participants

| Years of experience (years) | 1-5 | 6-10 | 11-15 | 16-20 |
|-----------------------------|-------------------|-------|-------|-------|
| Percentage (%) | 58.41 | 32.67 | 6.93 | 1.98 |
| Mean±SD | 5.12 ± 1.47 years | | | |

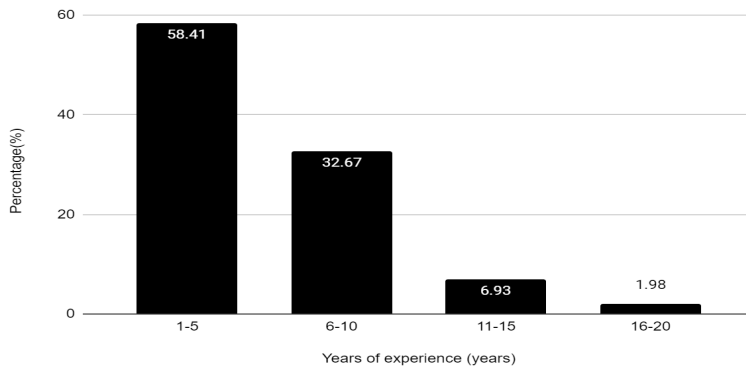


Figure 2. Years of Experience of the Participants

Table 3. Level of play of the Participants

| Level of sport | Tournaments | Zonal | District | State | National | International |
|----------------|-------------|-------|----------|-------|----------|---------------|
| Percentage (%) | 6.93 | 28.71 | 15.84 | 20.79 | 23.76 | 3.96 |

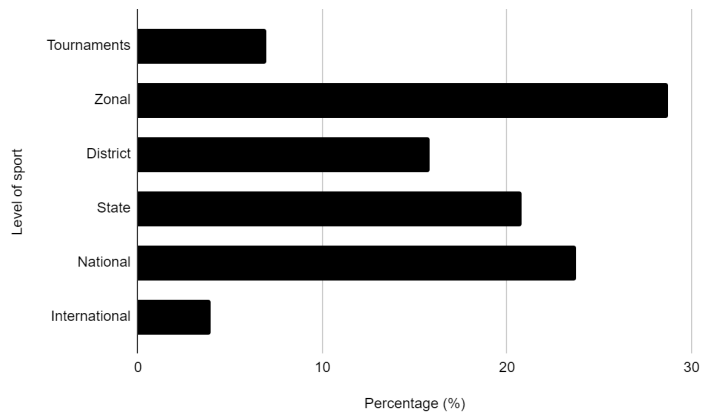


Figure 3. Level of play of the Participants

Table 4. Percentage of the participants aware of the term Female Athlete Triad

| Aware | Yes | No | Don't know |
|----------------|-----|----|------------|
| Percentage (%) | 35 | 49 | 16 |

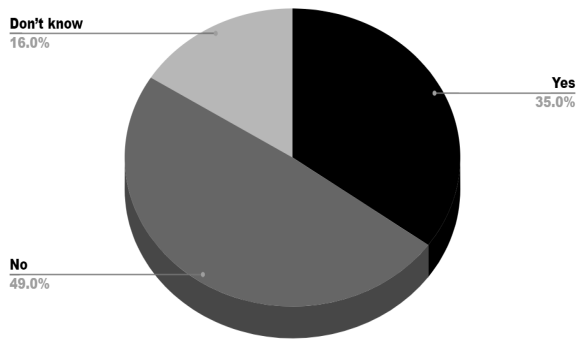


Figure 4. Percentage of the participants aware of the term Female Athlete Triad

Table 5. Percentage of the participants who identified the components of the triad

| Components | Percentage |
|---|------------|
| Osteoporosis | 8.91% |
| Osteoporosis + menstrual dysfunction | 5.94% |
| Eating disorder + menstrual dysfunction | 5.94% |
| Menstrual dysfunction | 14.85% |
| Eating disorder + osteoporosis | 2.97% |
| Eating disorder | 22.77% |
| None of the above | 13.86% |
| All of the above | 24.75% |

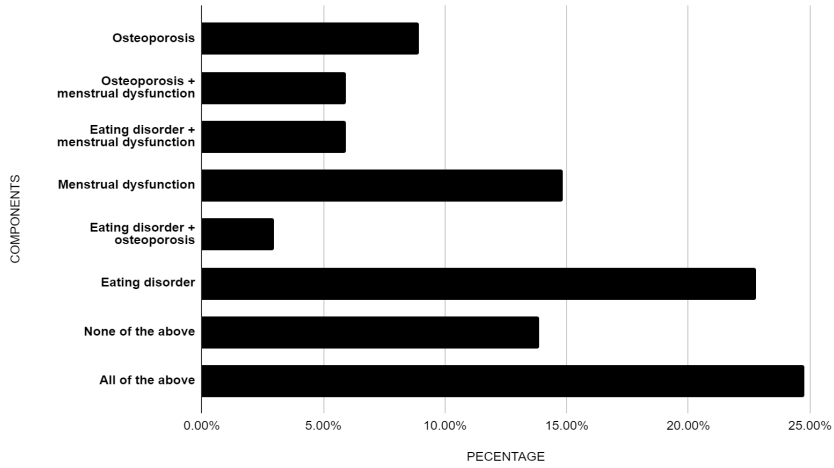


Figure 5. Percentage of the participants who identified the components of the triad

Table 6. Percentage of participants who related physical activity with symptoms of Low BMD, Low energy availability & Menstrual dysfunction

| Components | Low BMD | | | Low energy availability | | | Menstrual dysfunction | | |
|----------------|---------|-------|-------|-------------------------|-------|-------|-----------------------|-------|-------|
| | Yes | No | Maybe | Yes | No | Maybe | Yes | No | Maybe |
| Aware | | | | | | | | | |
| Percentage (%) | 46.53 | 38.48 | 14.99 | 39.73 | 47.65 | 12.62 | 36.63 | 44.16 | 19.21 |

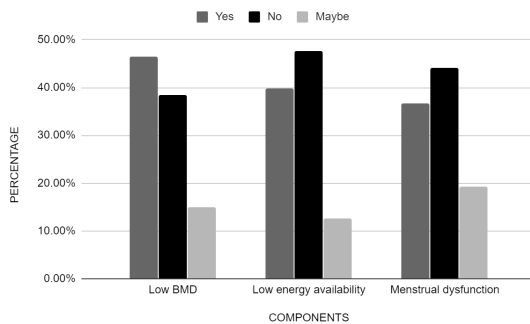


Figure 6. Percentage of participants who related physical activity with symptoms of Low BMD, Low energy availability & Menstrual dysfunction

Table 7. Awareness of the symptoms of Low Bone Mineral Density

| | Yes | No | Don't know |
|------------------------------|--------|--------|------------|
| Ca deficiency | 52.45% | 30.70% | 16.83% |
| Recurrent fractures | 57.40% | 28.71% | 13.86% |
| Stress fractures | 32.65% | 42.57% | 22.77% |
| Joint Pain | 61.39% | 29.70% | 8.91% |
| Body pain | 50.50% | 42.57% | 6.90% |
| Delayed wound healing | 29.70% | 49.50% | 20.79% |
| Fatigue | 39.60% | 45.55% | 14.85% |

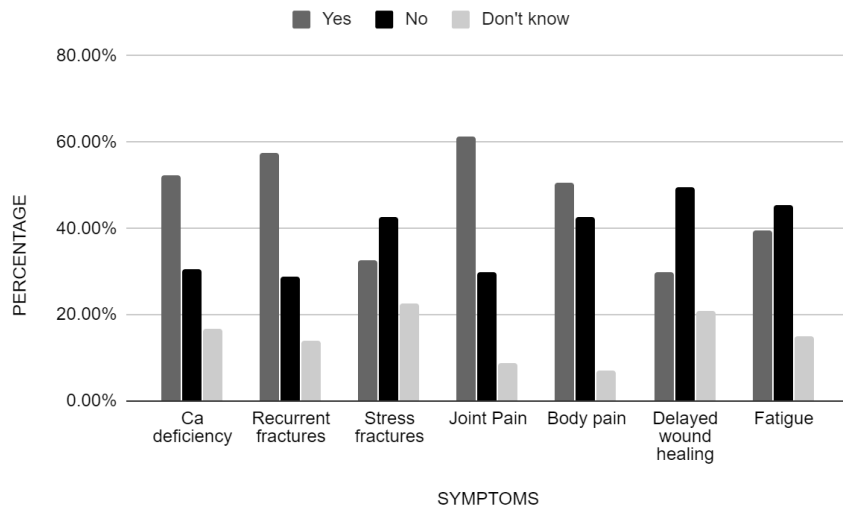


Figure 7. Awareness of the symptoms of Low Bone Mineral Density

Table 8. Awareness of the symptoms of Low Energy Availability

| | Yes | No | Don't know |
|----------------------------|--------|--------|------------|
| Counting calories | 52.48% | 33.66% | 13.86% |
| Food elimination | 54.46% | 35.64% | 9.90% |
| Binge eating | 36.63% | 48.52% | 14.85% |
| Induced vomiting | 14.85% | 64.36% | 20.79% |
| Body stigma | 33.66% | 56.44% | 9.90% |
| Fear of weight gain | 54.46% | 38.61% | 6.90% |
| Diet pills | 21.79% | 64.36% | 13.86% |
| Excessive eating | 49.50% | 39.60% | 10.90% |

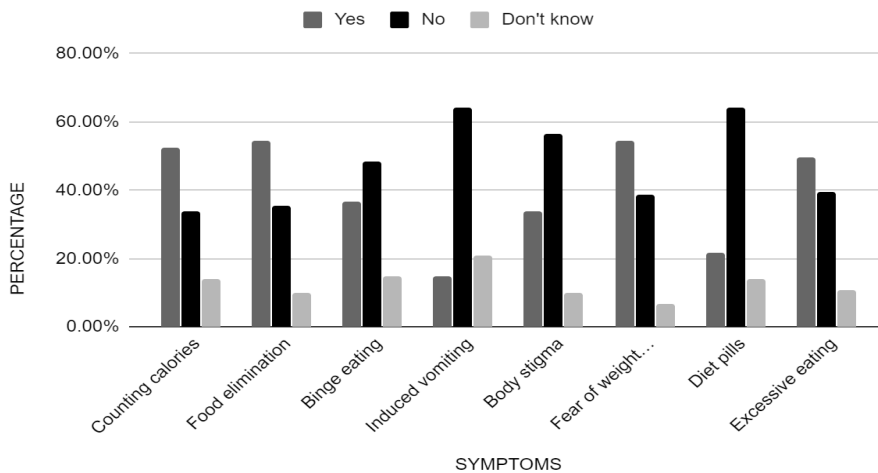


Figure 8. Awareness of the symptoms of Low Energy Availability

Table 9. Awareness of the symptoms of Menstrual Dysfunction

| | Yes | No | Don't know |
|--------------------------------|--------|--------|------------|
| Psychological issues | 57.43% | 29.70% | 12.87% |
| Orthostatic hypotension | 44.55% | 41.58% | 13.86% |
| Primary amenorrhea | 22.77% | 56.44% | 20.79% |
| Secondary amenorrhea | 25.74% | 50.50% | 23.76% |
| Oligomenorrhea | 32.67% | 42.57% | 24.75% |

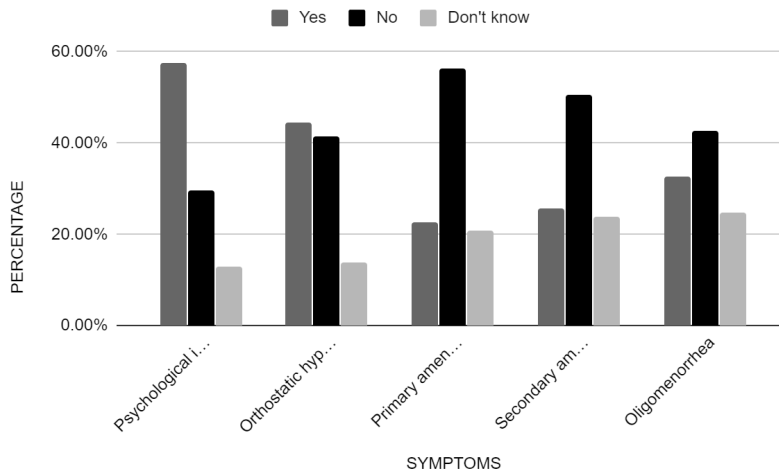


Figure 9. Awareness of the symptoms of Menstrual Dysfunction

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