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RED-S Identification on Female Athlete
Identificación RED-S en deportista femenina

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Abstract. RED-S is a contraindication for women in the sport. The purpose of the exercise was originally getting results in the form of a healthy and a fit body, but the female athletes when exercise is done with intensity is too high then suffered great mental distress that would arise RED-S disease include anorexia nervosa, amenorrhea, and osteoporosis. This study aims to identify the RED-S in women swimmer athletes. The results showed that the identification of RED-S in the women swimmer athlete is as follows: In objective based on the control of anorexia nervosa in detail that there were 26 (100%) athletes who entered in categories of anorexia nervosa. While the detailed control of amenorrhoea that there are 25 (96.15%) athletes who fall into the category of secondary amenorrhoea and 1 (3.85%) athletes who fall into the category of primary amenorrhoea. Then in the control of Osteoporosis in detail there are 0 (0%) athletes who fall into the category of high osteoporosis, 12 (46.15%) athletes who fall into the category of moderate osteoporosis, and 14 (53.85%) athletes who fall into the category of low osteoporosis. In Subjective based on the tendency of the RED-S, as many as three athletes (11.54 %) were in the category of very high, 3 athletes (11.54 %) were in the high category, 13 athletes (50.00%) were in the category of being, 5 athletes (19.23 %) were categorized as low, and 1 athlete (3.85%) were categorized as very low. While based on the RED-S risk factors, as many as four athletes (15.38%) were in the category of very high, 5 athletes (19.23%) were in the high category, 12 athletes (46.15%) were in the category medium, 2 athletes (7.69 %) were included in the low category, and 3 athletes (11.54%) were in the category of very low.
Keywords: RED-S, Female Athlete, Swimmer.

Resumen. RED-S es una contraindicación para las mujeres en el deporte. El propósito del ejercicio originalmente era obtener resultados en la forma de un cuerpo sano y en forma, pero las atletas, cuando el ejercicio se realiza con una intensidad demasiado alta, sufrieron una gran angustia mental que surgiría. La enfermedad RED-S incluye anorexia nerviosa y amenorrea. y osteoporosis. Este estudio tiene como objetivo identificar el RED-S en mujeres nadadoras deportistas. Los resultados mostraron que la identificación de RED-S en la deportista nadadora es la siguiente: En objetivo basado en el control de la anorexia nerviosa en detalle fueron 26 (100%) deportistas que ingresaron en categorías de anorexia nerviosa. Mientras que el control detallado de la amenorrea que hay 25 (96,15%) deportistas que entran en la categoría de amenorrea secundaria y 1 (3,85%) deportistas que entran en la categoría de amenorrea primaria. Luego en el control de la Osteoporosis en detalle hay 0 (0%) deportistas que entran en la categoría de osteoporosis alta, 12 (46,15%) deportistas que entran en la categoría de osteoporosis moderada y 14 (53,85%) deportistas que entran en la categoría de osteoporosis moderada. la categoría de osteoporosis baja. En Subjetivo según la tendencia de la RED-S, hasta tres atletas (11,54%) estaban en la categoría muy alta, 3 atletas (11,54%) estaban en la categoría alta, 13 atletas (50,00%) estaban en la categoría de ser, 5 deportistas (19,23%) fueron categorizados como baja y 1 deportista (3,85%) fue categorizado como muy baja. Mientras que según los factores de riesgo RED-S, hasta cuatro atletas (15,38%) estaban en la categoría muy alta, 5 atletas (19,23%) estaban en la categoría alta, 12 atletas (46,15%) estaban en la categoría media , 2 deportistas (7,69%) estaban incluidos en la categoría baja y 3 deportistas (11,54%) estaban en la categoría muy baja.
Palabras clave: RED-S, Deportista Femenina, Nadadora.

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Introduction

RED-S is a syndrome that often occurs in female athletes with high-intensity physical activity (Torstveit, M. K., *et al.* 2019; Yudhistira et al., 2021; Nugroho et al., 2021). RED-S is a combination of three related symptoms with each other associated with a high-intensity physical exercise performed by athletes (Williams, *et al.* 2019; Listyarini et al., 2021; Nasrulloh et al., 2020). These three symptoms include: 1) Anorexia nervosa, 2) Amenorrhea and 3) Osteoporosis (Koltun, K. J., *et al.* 2019; Sukendro et al., 2021; Amran et al., 2023). Even though the RED-S is associated with sports, RED-S not only happens to athletes. Besides athletes, another population at risk for RED-S is women who are active in physical activities in the military (Biesuz, R., *et al.* 2019; Ilham et al., 2021; Utami et al., 2023).

Lumba-Lomba Swimming Academy is a swimming academy which not only formed male athletes but also formed female athletes. The pattern of training run by female swimming athletes is not much different from the pattern of training carried out by male swimming athletes (Sutapa et al., 2020; Nasrulloh et al., 2022; Kogoya et al., 2023). Women's swimming athletes still do high intensity exercises to achieve the goal of training, which increases speed and agility (Nasrulloh et al., 2021; Nugroho et al., 2022; Trisnadi et al., 2023). When approaching competitions, athletes can perform 2 training sessions in a

day (Kroshus, E., *et al.* 2018; Sutapa et al., 2021; Salafi et al., 2022). In the morning doing cardio training followed by weight training programs with 80-95% intensity to increase muscle strength, then in the afternoon doing a tactical game training program to improve techniques and strategies (Kristiyanto et al., 2020; Jufrianis et al., 2021; Yuniana et al., 2023).

The atmosphere of female swimming athlete competition has also increased, therefore it is undeniable that the athlete's psychological condition is sometimes uncertain (Holtzman, B., *et al.* 2019; Saifu et al., 2021; Adji et al., 2022). This leads to an effect on exercise patterns, rest, and eating patterns. The need for the nutrition of women athletes should get more attention because female swimming athletes will greatly maintain her weight in order to remain steady while competing (De Souza, M. J., *et al.* 2020; Hardianto et al., 2022; Pratama et al., 2022). However, it is increasingly realized that high-intensity physical activities can also result in a negative impact on the mental, social and physiological health of athletes (Mountjoy, M., *et al.* 2018; Nopembri et al., 2022; Hastuti et al., 2021). Seeing the incident above, this study aims to identify RED-S in female swimming athletes in Lumba-Lomba Swimming Academy.

Materials and methods

Study participants

This study is a population study because the population is 26 people, then the sample is taken 100% or a number of 26 people with a questionnaire instrument. The samples used in this study were the women's swimming athletes who were included in the study inclusion as follows: (1) Athletes who are still active in provincial and national level, (2) in conditions ready to compete because of approaching competition, (3) perform high intensity exercises more than 7 times in a week.

Study organization

This research is a descriptive study with a quantitative approach that uses a sense-making method. The research was conducted at the Lumba-Lomba Swimming Academy, Bukit Jelutong, Selangor on Friday, December 13, 2020 at 15.00–18.00 PM. The population in this study was 26 female swimming athletes.

Statistical analysis

The research procedure is to socialize the RED-S on the subject followed by filling the subjective questionnaire to determine the trend and risk factor of RED-S. Then the subject was interviewed with an objective questionnaire and examination of bone density from Anlene to identify the RED-S symptoms experienced. The instruments in this study used a questionnaire that had been tested for validity and reliability by using expert judgment from experts in their fields. Data collection techniques used in this study were to provide a questionnaire to respondents to be filled in each question according to the instructions in the questionnaire. The questionnaire in this study is a closed questionnaire with 2 choices of answers, respondents only need to answer that has been provided, and each item of the questionnaire questions is provided two alternative answers: "Yes" (Y) if it supports ideas and "No" (T) if do not accept or support ideas. According to Suharsimi Arikunto (2002:144) that a good instrument must fulfill 2 important requirements that are valid and reliable. In this study, for the feasibility testing of instruments used in research using the validity of construct, which in the validity of the approval of expert judgment or experts in their field. Data analysis in this study uses quantitative descriptive data analysis techniques. The steps used are: (1) Summing up the respondent's answering score, (2) making the percentage, (3) categorizing the results of percentages.

The following is the formulation of the categories of each instrument according to Suharsimi Arikunto (2002: 168) as follows:

Table 1.
Control of anorexia nervosa

Class Interval	Category
≥ Calorie needs	No anorexia nervosa
< Calorie needs	anorexia nervosa

Table 2.
Control of Amenorrhea

Class Interval	Category
≤ 3 not menstruation	Secondary amenorrhea
≥ 4 not menstruation	Primary amenorrhea

Table 3.
Control of osteoporosis

Class Interval	Category
≤ -2.5	High
-2.5 – (-1)	Moderate
>-1	Low

Results

Objectively

In detail, the following will be described the data on the identification of RED-S experienced by female swimming athletes in the Lumba-Lomba Swimming Academy objectively.

Anorexia Nervosa Control is one of the objective factors in the identification of RED-S experienced by women's swimming athletes at the Lumba-Lomba Swimming Academy. In this study the control of Anorexia Nervosa is divided into two categories if more or equal to the needs of calories will be entered in the category is not Anorexia Nervosa whereas if less than calorie needs then it will enter in the category Anorexia Nervosa (Heikura, I. A., *et al.* 2018). Table 1 is a categorizing the control of Anorexia Nervosa on the identification of RED-S experienced by female swimming athlete in Lumba-Lomba Swimming Academy.

From the categorization of RED-S identification table

experienced by female swimming athletes in Lumba-Lomba Swimming Academy objectively at the control of Anorexia Nervosa above, it can be explained that in detail there are 0 (0%) athletes included in the category of no Anorexia Nervosa and 26 (100 %) athletes included in the Anorexia Nervosa category.

To be easier to understand, then presented an overview in the form of RED-S identification bar charts experienced by female swimming athletes in Lumba-Lomba Swimming Academy objectively at the control of Anorexia Nervosa as follows:

Table 4.
Categorization of RED-S identification experienced by female swimming athletes in Lumba-Lomba Swimming Academy objectively at the control of Anorexia Nervosa

Class Interval	Category	Frequency	Percentage
≥ Calorie needs	No Anorexia Nervosa	0	0 %
< Calorie needs	Anorexia Nervosa	26	100 %
Total		26	100 %

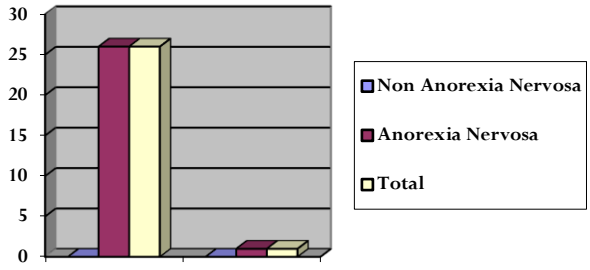

Figure 1. Histogram of objective categorization of anorexia nervosa

The main factor causing the female swimming athlete in Lumba-Lomba Swimming Academy to experience anorexia nervosa is minimization of eating patterns so that the weight does not exceed the class being contested.

Amenorrhea is one of the objective factors in the identification of RED-S experienced by female swimming athletes in Lumba-Lomba Swimming Academy. In this study Amenorrhea is divided into two categories including secondary amenorrhoea and primary amenorrhoea. Table 2 is a categorization of Amenorrhoea control in RED-S identification experienced by female swimming athletes in Lumba-Lomba Swimming Academy.

Table 5.
Categorization of RED-S Identification Experienced by female swimming athletes in Lumba-Lomba Swimming Academy Objectively in Amenorrhoea

Class Interval	Category	Frequency	Percentage
≤ 3 not menstruation	Secondary amenorrhea	25	96.15 %
≥ 4 not menstruation	Primary amenorrhea	1	3.85 %
Total		26	100 %

Based on the categorization of RED-S identification table experienced by female swimming athletes objectively in Lumba-Lomba Swimming Academy in Amenorrhoea control above, it can be explained that in detail there are 25 (96.15%) athletes who fall into the secondary Amenorrhoea category and 1 (3.85%) athletes included in the Primary Amenorrhoea category. The highest frequency is found in the secondary Amenorrhoea category at 96.15%.

To be easier to understand, then presented an overview in the form of RED-S identification bar charts experienced by female swimming athletes in Lumba-Lomba Swimming Academy objectively in Amenorrhoea as follows:

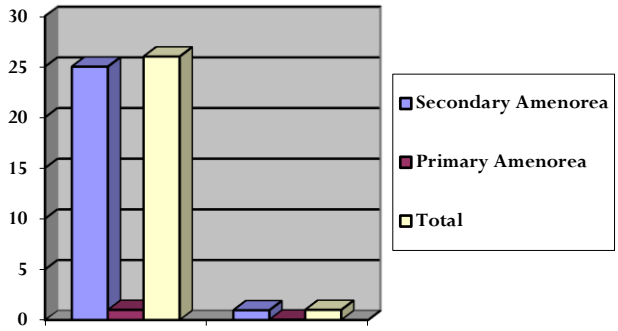

Figure 2. Histograms of objective categorisation of amenorrhea

Factors that cause female swimming athletes in Lumba-Lomba Swimming Academy to experience amenorrhoea are psychological conditions that affect the hypothalamus in the work system of the athlete's menstrual cycle.

Bone density is one of the objective factors in the identification of RED-S experienced by women's swimming athletes in Lumba-Lomba Swimming Academy. In this study, anareksi control is divided into three categories such as high, moderate, low (Kraus, E., *et al.* 2019). Table 3 is a categorizing of osteoporosis control on RED-S identification experienced by female swimming athletes in Lumba-Lomba Swimming Academy.

Table 6.
Categorization of RED-S Identification Experienced by female swimming athletes in Lumba-Lomba Swimming Academy Objectively in Osteoporosis Control

Class Interval	Category	Frequency	Percentage
≤ -2.5	High	0	0 %
-2.5 – (-1)	Moderate	12	46.15 %
>-1	Low	14	53.85 %
Total		26	100%

Based on the categorization of RED-S identification table experienced by female swimming athletes objectively in Lumba-Lomba Swimming Academy in Osteoporosis control above, it can be explained that there are 0 (0%) Athletes who are in the category of high osteoporosis, 12 (46.15%) Athletes who are in the category of moderate osteoporosis, and 14 (53.85%) Athletes in the category of low osteoporosis. The highest frequency is found in the low osteoporosis category of 53.85%.

To be easier to understand, then presented an overview in the form of RED-S identification bar charts experienced by female swimming athletes in Lumba-Lomba Swimming Academy objectively in Osteoporosis control as follows:

Factors that cause osteoporosis are when the diet is wrong then the intake of nutrients received by the bones will be reduced while in essence when the woman has

menstruation, substances that are wasted include calcium and iron.

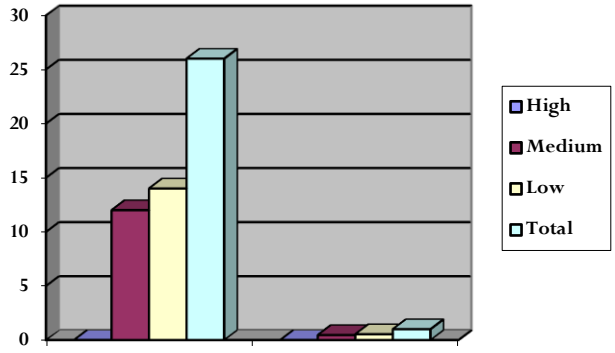

Figure 3. Histogram of objective categorization of osteoporosis

Subjectively

Subjectively identifying RED-S experienced by female swimming athletes in Lumba-Lomba Swimming Academy which is divided into two, are RED-S tendencies and RED-S risk factors. The following is going to detail the RED-S tendency and RED-S risk factor.

Based on RED-S, the maximum value is obtained = 11; minimum value = 0; average = 5; standard deviation = 2.64; median = 5 and mode = 6. Furthermore, the data are categorized into 5 categories, namely very low, low, medium, high, and very high categories based on Mean and Standard Deviation values. Table 1 is the norm calculation of the RED-S identification category experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on RED-S tendencies.

Referring to the calculated categorization of tendency, then RED-S identification frequency distribution of female swimming athletes in Lumba-Lomba Swimming Academy is based on the RED-S factor. Table 2 below is a frequency distribution of RED-S identification experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on the RED-S factors.

From the RED-S Identification Frequency Distribution table experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on the RED-S factor above obtained RED-S identification experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on the RED-S factor of 3 athletes (11.54%) were in the very high category, 3 athletes (11.54%) were in the high category, 13 athletes (50.00%) were in the medium category, 5 athletes (19.23%) who are in the low category, and 1 athlete (3.85%) in the very low category. The highest frequency is 50.00%, that is in the medium category. Thus the RED-S identification experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on the RED-S factor is medium.

To be easier to understand, then presented an overview in the form of RED-S identification bar charts experienced by female swimming athletes in Lumba-Lomba Swimming Academy objectively at the RED-S factor as follows:

Table 7.
Normative Calculation of RED-S Categorization Identification Experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on RED-S Tendencies

Formula	Boundary	Category
X ≥ M + 1.5SD	X ≥8.96	Very High
M + 0.5 SD ≤ X < M + 1.5 SD	6.32 ≤ X < 8.96	High
M – 0.5 SD ≤ X < M + 0.5 SD	3.68 ≤ X < 6.32	Medium
M – 1.5 SD ≤ X < M – 0.5 SD	1.04 ≤ X < 3.68	Low
X < M + 1.5 SD	X < 1.04	Very Low

Note: X = number of subject scores, M = average = 5, SD = standard deviation = 2.64

Table 8.
Distribution of Frequency of RED-S Identification Experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on RED-S Factor

No	Class Interval	Category	Frequency	Percentage
1	≥ 8.96	Very high	3	11.54 %
2	6.32 – 8.95	High	3	11.54 %
3	3.68 – 6.31	Medium	13	50.00 %
4	1.04 – 3.67	Low	5	19.23 %
5	< 1.03	Very low	1	3.85 %
	Total		26	100.00 %

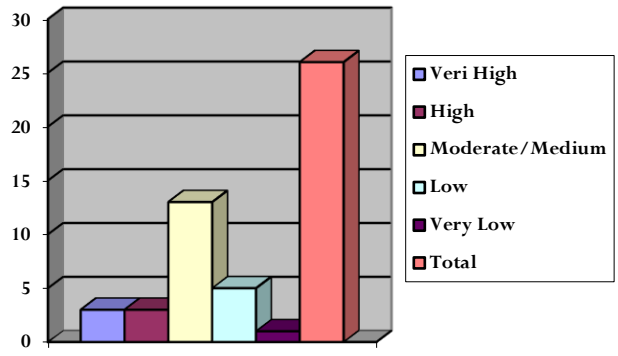

Figure 4. Histogram of frequency distribution of RED-S identification experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on RED-S factor

Based on the RED-S risk factor, maximum value is obtained = 12; minimum value = 3; average = 7.85; standard deviation = 2.68; median = 8 and mode = 9. Furthermore, the data are categorized into 5 categories, namely very low, low, medium, high, and very high categories based on Mean and Standard Deviation values. Table 1 is the norm calculation of the RED-S identification category experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on RED-S risk factors.

Table 9.
Normative calculation of RED-S identification categorisation experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on RED-S Risk Factors

Formula	Boundary	Category
X ≥ M + 1.5SD	X ≥11,86	Very High
M + 0.5 SD ≤ X < M + 1.5 SD	9.18 ≤ X < 11.86	High
M – 0.5 SD ≤ X < M + 0.5 SD	6.5 ≤ X < 9.18	Medium
M – 1.5 SD ≤ X < M – 0.5 SD	3.82 ≤ X < 6.5	Low
X < M + 1.5 SD	X < 3.82	Very Low

Note: X = number of subject scores, M = average = 7.85, SD = standard deviation = 2.68

Referring to the calculated categorization of tendency, then RED-S identification frequency distribution of female swimming athletes in Lumba-Lomba Swimming Academy is based on RED-S risk factors. Table 2 below is a frequency distribution of RED-S identification experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on the RED-S risk factors.

Table 10.
Distribution of Frequency of RED-S Identification Experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on RED-S Risk Factors

No	Class Interval	Category	Frequency	Percentage
1	≥ 11.86	Very High	4	15.38 %
2	9.18 – 11.85	High	5	19.23 %
3	6.5 – 9.17	Medium	12	46.15 %
4	3.82 – 6.49	Low	2	7.69 %
5	< 3.81	Very Low	3	11.54 %
	Total	26	100,00 %	

From the table above obtained RED-S identification experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on RED-S risk factors, as many as 4 athletes (15.38%) who were included in the very high category, 5 athletes (19.23%) included in the high category, 12 athletes (46.15%) were included in the medium category, 2 athletes (7.69%) were in the low category, and 3 athletes (11.54%) were in the very low category. The highest frequency is 46.15%, in the medium category. Thus the RED-S identification experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on the RED-S risk factors is medium.

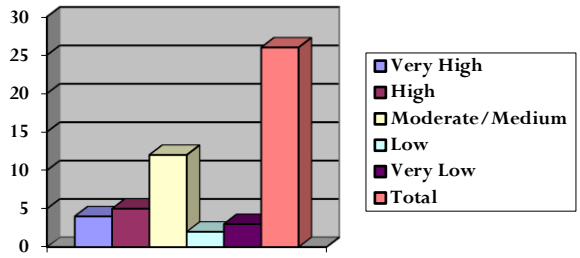

Figure 5. Histogram of the RED-S identification experienced by female swimming athletes in Lumba-Lomba Swimming Academy based on the RED-S risk factors

Discussion

The implications in this study were that the identification of RED-S experienced by Lumba-Lomba Swimming Academy is medium, can be considered as a consideration for trainers and athletes, to understand the importance of knowledge of good diet with appropriate nutritional intake, good training portions to reduce the risk of RED-S.

This research has been tried as best as possible, but it could not be separated from the limitations of research including this research has not concluded the data using methods of data triangulation.

Suggestions that can be given are as follows: (1) Recommended to the instructors of Lumba-Lomba Swimming Academy always provide direction to female athletes in order to reduce the risk of RED-S. (2) To maintain personal health through diet and exercise intensity to reduce the risk of the occurrence of RED-S. (3) Recommended to the management of Lumba-Lomba Swimming Academy to involve a psychologist in the effort to maintain the mental condition of athletes to always in prime condition and not suffer from depression due to competitive atmosphere.

Conclusions

This study states that female swimming athletes in Lumba-Lomba Swimming Academy experience RED-S in the medium category. The facts collected from female swimming athletes in the Lumba-Lomba Swimming Academy as research subjects, that female swimming athletes in the Lumba-lomba Swimming Academy are still vulnerable to the risk of RED-S. This can be seen from the questionnaire statements which state the level of tendency for RED-S and RED-S risk factors to be in the medium category. Thus, it is hoped that the results of this study can contribute to science in general, and sports knowledge in particular.

By knowing that the RED-S identification experienced by female swimming athletes in the Lumba-Lomba Swimming Academy is moderate, it can be taken into consideration for coaches and athletes, in order to better understand the importance of knowledge about a good diet with appropriate nutritional intake, good portion of exercise to reduce the risk of RED-S.

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Conflict of interest

All the authors of this research declare if there is no conflict of interest for this research.

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