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Investigation of nutritional status, VO2max, agility, speed, and strength: A cross-sectional study in basketball athletes

Muh Adnan Hudain[1abcd,*], Ilham Kamaruddin[1cde], I Putu Agus Dharma Hita[2bcd], Doni Pranata[3bce], & Elsa Ariestika[4acd]

Universitas Negeri Makassar, Indonesia[1]
Universitas Triatma Mulya, Indonesia[2]
Universitas Tanjungpura, Indonesia[3]
Universitas Prima Graha, Indonesia[4]

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ABSTRACT

Nutritional status, VO2max, agility, speed, and strength are very important factors for every athlete to achieve maximum performance, especially in basketball. This study aims to determine the level of nutritional status, VO2max, agility, speed, and strength of Jembrana Regency basketball athletes in Preparation for the 2022 Bali Provincial Sports Week Championship. The sample in this study consisted of 12 men's basketball athletes, Porprov Jembrana Regency, using the total sampling technique. The type of research used in this research was a cross-sectional study. The instruments used to collect data in this study were the Body Mass Index to measure nutritional status, the Multistage Fitness Test to measure VO2max, the Illinois Agility Test to measure agility, the 30M Sprint Test to measure speed, and the Push Up & Sit Up Test to measure muscle strength; belly and arms. The study found that the average nutritional status was normal, VO2max was good, agility was good, speed was very poor, arm muscle strength was good, and abdominal muscle strength was very good. The results of the study could assist Jembrana Regency get a good idea of how the athletes are training and how well the staff and teachers are working together. This is important for getting the best results at the Bali Provincial Sports Week championship. Based on the study's results, the best way to get ready for the Bali Provincial Sports Week championship is for players to get in better shape, especially in terms of biomotor VO2max and speed, which are still not good enough. So, more study can be done to re-evaluate these biomotors and add more physical test markers so that players' physical success can be tracked as well as possible.

Keywords: VO2max; nutritional status; speed; agility; strength

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Corresponding Author: Muh Adnan Hudain**,** Department of Physical Education, Health, and Recreation, Faculty of Sport and Health Sciences, Universitas Negeri Makassar, Makassar, Indonesia
Email: muh.adnanhudain@unm.ac.id

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INTRODUCTION

Sport is a form of physical activity that has many benefits for the body, one of which is that the body becomes healthy and fit (OsmanİmamoğIu, 2016). Lack of physical activity can have an impact on reducing

a person's aerobic capacity, thereby accelerating fatigue during daily activities (Izquierdo et al., 2021). This opinion is supported by the opinion expressed by (Fraser et al., 2022) to be able to have maximum physical quality, individuals must design optimal nutritional intake. In addition, optimal nutrition must be consumed regularly. One of the activities using aerobic capacity is basketball. Basketball requires energy in the characteristics of the game (Fort-Vanmeerhaeghe et al., 2016). The game of basketball requires optimal physicality, this is due to the fast intensity of the game and the distribution of the ball for both defense and fast attack patterns (Mateus et al., 2019). Because it needs to be prepared for strength, endurance, speed, and agility in playing it (Morrison et al., 2022). So that the aerobic capacity in basketball becomes a support for achieving optimal performance. Sports achievements, in general, are created by several factors, one of which is the pattern of the coaching process (Meyer et al., 2017).

In Indonesia, the process of fostering sports is carried out massively, from the regions to the provinces. Competitions at the provincial scale level, more commonly known as Porprov, Porprov are competitions held between provincial regencies (Afrilliyan et al., 2018). The competition is a benchmark to make evaluation material for coaching in the district to maximize the process of fostering achievement in certain sports (Hanif, 2021). In addition, this result is an evaluation material to prepare for the next tiered competition, namely the highest competition between provinces, more commonly known as the national sports week, which is held every four years (Hadi, 2015).

Jembrana Regency is a district in the province of Bali; Jembrana district is a contestant in the province-wide competition in the province of Bali. There are several sports that the Jembrana district is participating in the 2022 Porprov activities, one of which is basketball. To form maximum performance, of course, many technical things have been prepared to face Porprov competition. Among them is analyzing the biomotor components, which are closely related to the sport of basketball, so that the athletes who are sent out are athletes who are ready to compete. Each sport has its own characteristics, related to the dominant biomotor. This is in accordance with the rules and how to play in these sports, the sport of basketball itself has dominant bimotors including strength, power, agility, and speed (Davis et al., 2022). The dominant physical characteristics in basketball are agility, speed, strength and endurance (Wicaksono & Himawanto, 2021). This is adapted to the sport of basketball which is played for a long time, the tempo is fast and requires strength so that it can be maximized in the process of basic techniques of passing, dribbling and shooting (Iqroni, 2022).

In addition to these biomotors, athletes must also be given a balanced supply of nutrition; by definition, nutrition is the content of nutrients that are good for the body so that these nutrients can become fuel for the body to carry out activities optimally (Al-Gizi et al., 2022). For athletes to get balanced nutrition, food nutrition must pay attention to the guidelines already available; these guidelines are better known as balanced nutrition guidelines. Guidelines for balanced nutrition contain the composition of daily food containing nutrients in the type and amount according to needs (Siregar & Tinah, 2021). There are several behaviors that can support individual physical activity, including consuming food optimally, living a clean and healthy life, and always doing regular physical activity (Mazloomi et al., 2022). With regard to the analysis of several factors that support the creation of athletes who excel in basketball, namely in terms of the biomotor aspects which are closely related to specific sports and the Body Mass Index of athletes, through this research whether the biomotor aspects and Body Mass Index have a level of relevance that is related to affecting VO2max level athletes in basketball, this is because the sport of basketball really requires a high VO2max level in playing these matches so that athletes can play optimally.

Based on previous monitoring, nutritional status, VO2max, agility, speed, strength are very important factors for every athlete to have. Based on this, the researcher wanted to carry out this research because previously he had never conducted research related to Jembrana District Basketball Athletes. In addition, based on the record of achievements obtained by the Jembrana Regency Basketball Team in previous events, very few achievements/medals were obtained. Therefore, researchers were interested in analyzing the variables related to support for improving basketball skills. Many previous studies linking nutritional status, VO2max, agility, speed, and strength have been carried out, such as (Arifan et al., 2021; Ma'arif & Mahfud, 2022; Setia & Winarno, 2021) which linked the variables to be studied in this research. Other research

related to physical abilities are (Afshari et al., 2021; Ariestika & Nanda, 2020; Forenza et al., 2020; Herpandika et al., 2019; Putra & Ita, 2019).

However, to the author's knowledge, no one has reported the results of research on the variables nutritional status, VO2max, agility, speed, and strength which were carried out after the Covid-19 pandemic and were carried out on respondents from the Jembrana Regency Basketball Team, especially during the preparation period for the 2022 Bali Porprov event. Therefore, the purpose of this study is to analyze nutritional status, VO2max, agility, speed, and strength in Jembrana Regency Basketball Team athletes in preparation for the 2022 Bali Porprov event. Therefore this study focuses on analyzing nutritional status, VO2max, agility, speed, and strength in basketball athletes in Jembrana Regency in preparation for Porprov Bali. This research is very important to do because this research is the first research conducted on Jembrana District Basketball Athletes.

The novelty of this research lies in its contribution to the understanding of physical fitness and nutritional status, VO2max, agility, speed, strength in the population of the Jembrana District basketball team in preparation for the Bali Province Sports Week Championship. The research results can be used for nine trainings and conditioning programs that aim to improve athletes' performance by targeting their specific areas of weakness. This study focused on the population, namely the Jembrana District basketball team, and the aim is to assess several factors of physical fitness (nutritional status, VO2max, agility, speed, and muscle strength) in preparation for provincial-level championships and to be used as evaluation material for coaches.Thus, through this research, it can make a scientific contribution to achievement sports to maximize the potential of athletes through strategies developed through integrated, sustainable, and specific training programs following the characteristics of these sports.

METHOD

This study aims to determine the level of nutritional status, VO2max, agility, speed, and strength of basketball athletes in Jembrana Regency in Preparation for the 2022 Bali Provincial Sports Week (Porprov) Championships. The population in this study were male basketball athletes from Porprov Jembrana Regency, totalling 14 people. The sampling technique in this study used a type of total sampling, namely all members of the population were used as research samples (Winarno, 2013). The type of research used in this study was a cross-sectional study. This observational study analysed variable data collected at a particular time across a predetermined sample population or subset (Siyoto & Sodik, 2015). The instrument used to collect data in this study was the Body Mass Index to measure Body Mass Index using the following formula:

$$\text{BMI} = \frac{\text{Weight (kg)}}{\text{Height}^2 \text{ (m)}}$$

After analysing the above formula, the results can be seen in the following tables: Table 1 contains the Norms for the Body Mass Index Category, which is used to classify a person's weight based on height and weight. Furthermore, Table 2 is the Illinois Agility Test Norms, which provide a reference on the level of agility based on what is considered a good or average time to complete the test, taking into account age group and gender. Table 3 contains the Norms of Assessment for the 30-Metre Acceleration Test, which provide norms for measuring speed in the 30-metre running test. Furthermore, to assess abdominal muscle strength, Table 4 and Table 5, the Norms of Assessment of Push-Up and Sit-Up Tests, provide a reference on how well a person can do push-ups or sit-ups based on age and gender. With the information contained in these tables, we can identify body mass index categories, assess agility levels, measure speed, and evaluate abdominal muscle strength based on predetermined norms.

Table 1. Norms for Body Mass Index Category

Category		BMI
Thin	Heavy	< 17,0
	Light	17,0 - 18,4
	Normal	18,5 - 25,0
Fat	Light	25,1 - 27,0
	Heavy	> 27

(P2PTM, 2018)

Table 2. Illinois Agility Test Norms

Gender	Excellent	Very Good	Good	Low	Very Low
Man	<15.2	15.2-16.1	16.2-18.1	18.2-18.3	>18.3
Women	<17.0	17.0-17.9	18.0- 21.7	21.8-23.0	>23.0

(Singh & Bal, 2018)

Table 3. Norms of Assessment of 30 Meters Acceleration Test

Man	Criteria	Women
<4.0	Excellent	<4.5
4.2-4.0	Very Good	4.6-4.5
4.4-4.3	Good	4.8-4.7
4.6-4.5	Low	5.0-4.9
>4.6	Very Low	>5.0

(Singh & Bal, 2018)

Table 4. Push-Up Test Assessment Norms

Category	Age				
	≤29	30-39	40-49	50-59	60+
	Man				
Excellent	>54	>44	>39	>34	>29
Very Good	45-54	35-44	30-39	25-34	20-29
Good	34-44	25-34	20-29	15-24	10-19
Low	20-34	15-24	12-19	8-14	5-9
Very Low	<20	<15	<12	<8	<5
Category	Women				
Excellent	>48	>39	>34	>29	>19
Very Good	34-48	25-39	20-34	15-29	5-19
Good	17-33	12-24	8-19	6-14	3-4
Low	6-16	4-11	3-7	2-5	1-2
Very Low	<6	<4	<3	<2	<1

(Singh & Bal, 2018)

Table 5. Sit-Up Test Assessment Norms

Man	Criteria	Women
>30	Excellent	>25
26-30	Very Good	21-25
20-25	Good	15-20
17-19	Low	9-14
<17	Very Low	<9

(Singh & Bal, 2018)

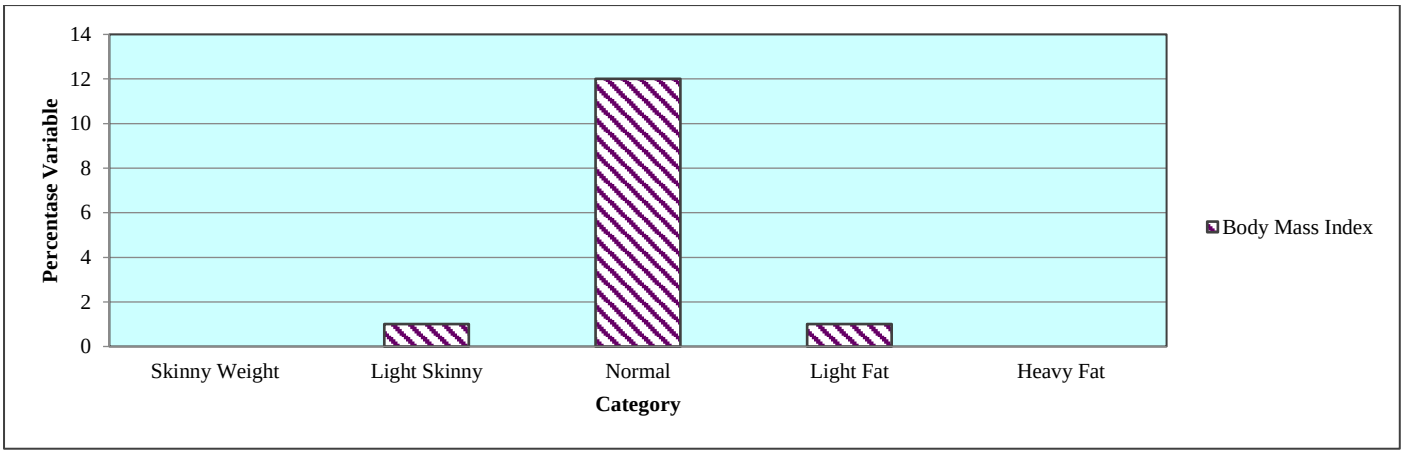
RESULTS AND DISCUSSION

This research was conducted by starting to measure the Body Mass Index using the BMI formula. Measurement of height (cm) squared and weight (kg). In addition, VO2max measurements were also carried out using the Multistage Fitness Test, Agility measurements using the Illinois Agility Test, Speed

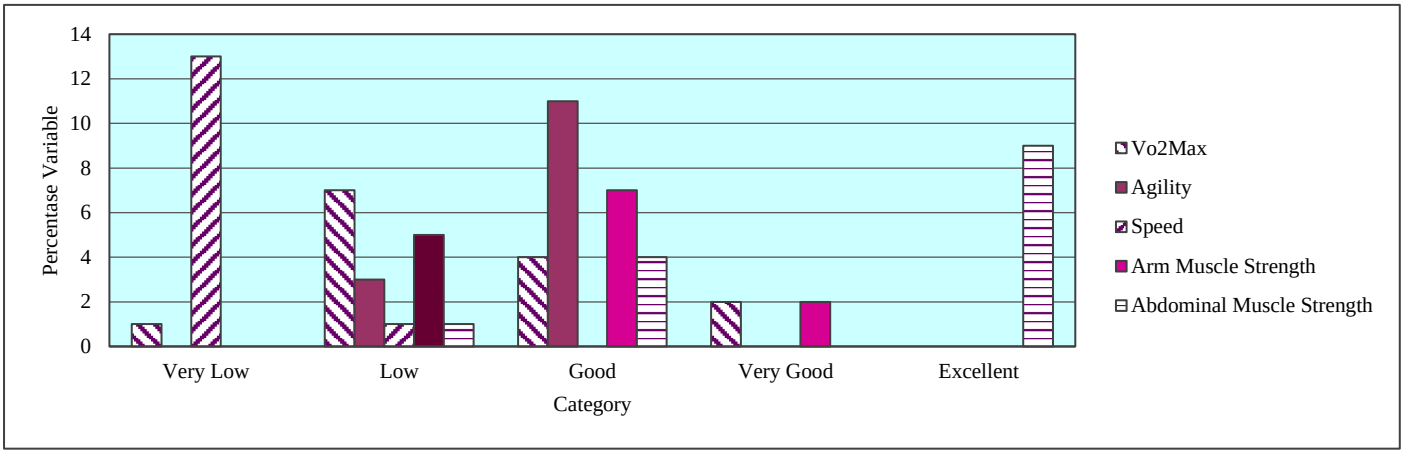
measurements using the 30M Sprint Test, and Strength measurements using the Push Up & Sit Up Test. Based on the results of body mass index measurements, it was found that 1 (7.1%) athlete was in the light skinny category, 12 (85.7%) athletes were in the normal category, and 1 (7.1%) athlete was in the light fat category. Based on the calculation results, it is concluded that the Body Mass Index was in the normal category. Based on the measurement results for each variable, it was found that for VO2max there were 1 (7.1%) athlete in the very low category, 7 (50%) athletes in the low category, 4 (28.6%) athletes in the good category and 2 (14.3%) athletes are in the very good category, so it can be concluded that the athlete's VO2max was in the good category. For agility, it was found that 3 (21.4%) athletes were in the low category, 11 (78.6%) athletes were in the normal category, so it can be concluded that agility was in the normal category. For speed, 13 (92.9%) athletes were found in the very low category, 1 (7.1%) athlete was in the low category, so it can be concluded that speed was in the low category. For arm muscle strength 5 (35.7%) athletes are in the low category, 7 (50%) athletes were in the good category, 2 (14.3%) athletes were in the very good category, so it can be concluded that arm muscle strength was in the good category. For abdominal muscle strength, 1 (7.1%) athlete was in the low category, 4 (28.6%) athletes were in the good category, 9 (64.3%) athletes were in the excellent category, so it can be concluded that abdominal muscle strength are in the excellent category. The data collected in this study is presented in the form of a frequency distribution as follows:

Table 6. Frequency Distribution of Research Data

Variable	Category				
	Skinny Weight	**Light Skinny**	**Normal**	**Light Fat**	**Heavy Fat**
Body Mass Index	0 (0%) Very Low	1 (7.1%) Low	12 (85.7%) Good	1 (7.1%) Very Good	0 (0%) Excellent
VO2max	1 (7.1%)	7 (50%)	4 (28.6%)	2 (14.3%)	0 (0%)
Agility	0 (0%)	3 (21.4%)	11 (78.6%)	0 (0%	0 (0%)
Speed	13 (92.9%)	1 (7.1%)	0 (0%)	0 (0%)	0 (0%)
Arm Muscle Strength	0 (0%)	5 (35.7%)	7 (50%)	2 (14.3%)	0 (0%)
Abdominal Muscle Strength	0 (0%)	1 (7.1%)	4 (28.6%)	0 (0%)	9 (64.3%)



Graph 1. Result Body Mass Index



Graph 2. Frequency Distribution of Research Data

The Body Mass Index of basketball athletes at the Provincial Sports Week (Porprov) is in the normal category. This shows that nutritional fulfilment has an impact on body mass index. By consuming a balanced and nutritious diet, athletes will have a normal body mass index. Conversely, underconsumption or excessive consumption also negatively affects body mass index. Malnutrition leads students into underweight, while excess nutrition causes students to enter the category of obesity. Currently, obesity is considered a condition influenced by caloric intake to consumption (Satrio & Winarno, 2019). In addition, nutritional fulfilment is also influenced by gender; boys and girls have different levels of nutritional adequacy (Friedlander et al., 2018). Fulfilment of nutrition is commonly known as energy intake. Ideally, maintaining energy balance should be done daily by paying attention to daily energy expenditure following energy intake (Sari et al., 2020). Irregular eating patterns will affect body mass index because intake is not balanced with output. Diet, obesity, and physical activity all have important impacts on health (Perez-Schindler et al., 2015). Measuring dietary patterns and wrong food consumption can also be considered a particular body mass index (Stellingwerff et al., 2019). Fulfilment of balanced nutrition in athletes, especially at the growth and development stage, has a positive impact on their bodies. Excessive nutrition will hinder the activities of athletes in everyday life. Active physical movement affects body mass index, reducing the risk of excess nutrition (Reale et al., 2020). Fulfilment of nutrition plays a role in increasing body mass index. Therefore, fulfilling balanced nutrition with special attention to the right diet will help increase body mass index. The body mass index of basketball athletes also affects how optimal the VO2max of basketball athletes at Provincial Sports Week is (Porprov).

The VO2max of the Provincial Sports Week (Porprov) basketball athletes is included in the good category. Athletes' training for each component requires an efficient and effective method, such as training volume, intensity, training breaks (training intervals), and training frequency (Wisløff et al., 2019). So that basketball athletes at the Provincial Sports Week (Porprov) are based on factors that affect VO2max, including gender, age, physical exercise, temperature, cardiovascular function, lungs, haemoglobin in red blood cells, body composition, and height. Thus, VO2max in athletes is also a limitation of aerobic ability, therefore it is the best parameter to measure the aerobic capacity of athletes. Previous studies reported that the peak value of VO2max in men was reached at the age of 17-25 years. The results of this study indicate that the average age of Pencak Silat athletes is close to peak age with an average age of 15.83 years compared to sports athletes with an average age of 15.00 years (Black et al., 2016). However, the VO2max value of game sports athletes is greater than that of martial arts athletes. Thus, the type of exercise, movement intensity, and duration in the biomotor component significantly influence the athletes' VO2max ability (Ando et al., 2019). VO2max that is not optimal interferes with other physical activities, especially in match performance, so basketball athletes also have to have suitable biomotor components, one of which is agility.

In the agility of basketball athletes at the Provincial Sports Week (Porprov) the results were in a normal category. Many researchers have recognized the importance of the biomotor component in decision-making when assessing agility in athlete-team sports, especially basketball (Abbas et al., 2017). Premeditated agility in basketball players has predominated, with only one known study using agility technique skills (Utamayasa et al., 2020). This is in line with the results of research by Thompson et al. (2017) which explains that the warm-up effect on reactive agility in adolescents (16.3 ± 0.7 years) basketball athletes uses reactive agility tests, which consist of perception, decision-making, and movement response components that make the agility results of basketball athletes more optimal. While basketball players in Porprov athletes lack cognitive abilities and find it difficult to participate in matches in the senior category. So that the agility of Porprov basketball players can increase their understanding of agility performance in sports. The agility of basketball athletes depends on the perceptual and decision-making components (visual scanning, situational knowledge, pattern recognition, and anticipation) and physical qualities (technique, linear speed, leg muscle quality, and morphology) (Conde et al., 2021). As expressed by Sporiš et al. (2017), agility is very important in the game of basketball, and this shows general characteristics. Besides that, De Giorgio et al. (2018) also state that agility can be defined as a physical skill that allows an athlete to quickly and efficiently change direction, speed up, and slow down in an effort to react appropriately. So if every basketball player has good agility and speed, it can support player movements such as chasing or avoiding opponents and reacting to ball movements.

Movement speed in basketball athletes at the Provincial Sports Week (Porprov) is included in the poor category after data analysis research was conducted. The basketball game is a game that requires swift body movements, which are determined by the situation in the match (Schumaker et al., 2017). Therefore, to support fast movements, good speed is needed. In basketball, players repeatedly run, stop, and take turns according to the situation to run around the court throughout the game. It is essential to objectively understand the movement intensity and quantity of movement made by a player during a match for a training program for performance improvement (Ekúndayò et al., 2020). So, by targeting the quality of playing basketball, the distance and speed of the players and the ball are the determining factors in the physical fitness component, which is dominated by the strength of the arm muscles in carrying out technical movements in the game of basketball.

Arm and abdominal muscle strength were included in the sound and excellent categories in basketball athletes at the Provincial Sports Week (Porprov). Movement in the arm when shooting requires a biomotor component, one of which is strength. Thus, it can be said that the strength of the arm muscles is related to the shooting skills athletes possess. In addition, researchers found that each athlete can increase arm muscle strength for optimal match performance. However, in his work (Ekúndayò et al., 2020), he states that the abdominal muscles function to stabilise movements when performing motion skills in basketball games. Thus, the stronger the abdominal muscles will be the more stable when shooting while jumping. If the strength in the abdominal muscles gets weaker, the stability of the body when performing movement skills will be more difficult.

The research on the body mass index of basketball athletes at the Provincial Sports Week (Porprov) shows that nutritional fulfilment has an impact on the body mass index, but there were limitations in measuring dietary patterns and food consumption that can affect body mass index. The VO2max of basketball athletes is another limitation of aerobic ability, and its optimal value is essential for match performance. The agility of basketball athletes depends on perceptual and decision-making components and physical qualities. Finally, the research shows that movement speed is an essential factor in basketball, and it requires specific training to improve the performance of the athletes.

CONCLUSION

The study looked at the nutritional status, VO2max, agility, and movement speed of basketball athletes at the Provincial Sports Week (Porprov). The body mass index was found to be in the normal category, and balanced nutrition plays a role in increasing body mass index. The VO2max of the athletes was included in the less category, and various factors affect VO2max, such as gender, age, physical exercise, and body

composition. The agility of the athletes was found to be in a suitable category, and it depends on perceptual, decision-making components and physical qualities. However, the movement speed was found to be in the poor category, which could be improved to support fast movements required in basketball. The drawback in this study is that the sample used is limited to athletes participating in Porprov. Therefore, to see the overall state of the nutritional status and physical condition of basketball athletes, a larger sample is needed involving all athletes who are members of clubs in Jembrana district so that the evaluation can be done thoroughly to determine the right training program for basketball athletes. So that the regeneration of Jembrana district basketball athletes can be maintained in terms of their physical and nutritional status.

Since the body mass index of athletes affects their body mass index and VO2max, future research can focus on the impact of dietary interventions on the VO2max of basketball athletes. It can investigate the effect of dietary modifications on the VO2max, body mass index, and agility of basketball players. Additionally, researchers can explore the factors that influence movement speed in basketball athletes and identify effective training methods that enhance the speed of basketball athletes. Lastly, cognitive interventions can be introduced to assess the impact of cognitive abilities on the agility of basketball players. The research can investigate whether specific cognitive training leads to improved agility and better performance in basketball athletes.

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CONFLICT OF INTEREST

In writing this article, all authors declare that there is no conflict of interest

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