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Design validity of interval and plyometric training programs for simultaneous increases in VO_2 max, reactive agility, power in basketball: Aiken validity

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Abstract
The purpose of this study was to test the content validity of the design in interval training and plyometrics to simultaneously increase VO_2 max, reactive agility, and power. The population of the study were basketball athletes from the Special Region of Yogyakarta aged 13-18 years with 40 athletes as research sample. The sample was obtained through random sampling technique. The research subjects used 7 experts and the data collection used the Delphi technique. Data analysis employed Aiken's V formula. The results of data analysis show that the coefficient of Aiken's V is above 0.80, so that all aspects of the design of the plyometric training program and interval training program can be said to be valid. Thus, the results of the study can be concluded that the design of interval and plyometric training programs for increasing VO_2 max, reactive agility, and power in basketball has sufficient content validity with Aiken.

Keywords: VO_2 Max, basketball, interval, plyometric, reactive agility, leg power

1. Introduction
Basketball is an intermittent sport and is carried out for a relatively long time with high intensity [1]. Under the rules of the International Basketball Federation, the duration of a basketball game is 4 x 10 minutes [2]. Therefore, players must have good physical condition supported by a high level of aerobic fitness. That is, players must have good aerobic endurance. Basketball players who have good aerobic endurance will find it easier to regulate the rhythm of the game and maintain performance during matches [3]. The game of basketball also requires high-speed movement when changing direction after receiving a stimulus, running quickly to return to the back or attack, jumping vertically to grab the ball, and shooting the ball to get points. [4]. Thus, playing basketball requires good VO_2 max, reactive agility, and leg power abilities [5].

VO_2 max, reactive agility, and leg power are bio motor components that are needed by basketball players. To be able to improve these abilities, an appropriate training method and model are needed, so that training can be applied effectively and efficiently. Interval and plyometric training are one of the training methods used to increase power. Several studies have shown that plyometric training methods can increase leg power [6]; VO_2 max [7]; agility [8]. Other facts from the results of previous studies also show that the interval training method can effectively increase VO_2 max, reactive agility, and leg power [9, 10, 11]. Thus, it can be assumed that interval and plyometric training methods can be used to improve the physical components of basketball. The results of observations of trainers for the Special Region of Yogyakarta show that the implementation of the physical training program is still partial (Not yet holistic), especially to increase the VO_2 max, reactive agility, and leg power of basketball players.

Furthermore, the study conducted by [12] also involved children aged 13-18 years where the condition of the children had just entered the training to train and training to compete for stages. The results of this research show that the training given to children aged 13-18 years is not fully oriented towards becoming champions, but rather at learning to compete.

That is, training goals and objectives are more geared towards optimizing specific individual fitness and skill levels. Therefore, basketball players who have a high level of fitness will find it easier to achieve optimal performance. Interval training and modification of plyometric exercises are expected to increase VO_2 max ability, reactive agility, and leg power in basketball players aged 13-18 years simultaneously [13, 14]. The results of a search of the literature review found no evidence related to the effectiveness of applying interval and plyometric training methods to increase VO_2 max, agility, and leg power of basketball players, especially for children aged 13-18 years. This means that the design of interval and plyometric training to increase VO_2 max, reactive agility, and leg power simultaneously does not yet have content validity that can be used as a guideline in implementing the exercise.

Research studies related to the application of interval training and plyometric methods are only limited to differences in influence and changes as a result of the treatment given. Almost all applications are oriented towards increasing bio motor abilities such as endurance, strength, reaction, speed, agility, and explosive power. But research related to the comparison between interval training and plyometrics to increase VO_2 max, reactive agility and leg power in basketball athletes concurrently has never been done. Research on the application of interval and plyometric training methods based on age differences also does not have many references. This means that previous research is still general and not specific on the dominant component abilities needed in basketball games based on age differences. For this reason, this study deals in detail with the effect of differences are they similar in the coaches' opinion in interval training and plyometrics to increase VO_2 max, reactive agility, and leg power in basketball athletes aged 13-18 years. Another fact shows that previous research tends to see differences in the results of the treatment carried out by researchers on physical fitness, such as VO_2 max, reactive agility, and leg power. This means that the training model applied in the research does not have a definite validity value, so it does not have scientific evidence that is suitable for application to different subjects and places, especially for basketball players aged 12 to 18 years [15-17]. In other words, ages 12 to 18 years affect on the sounds like training rather than content validity development of components of physical fitness, namely VO_2 max, reactive agility, and leg power. However, there are still few research results that analyze VO_2 max, agility, and leg power aged 13-18 years in basketball athletes.

The results of interviews with 9 basketball coaches in the Special Region of Yogyakarta found that 4 coaches stated that using the interval training method applied separately was more effective for increasing VO_2 max, reactive agility, and leg power of basketball players. Meanwhile, 5 trainers stated that using the plyometric training method to increase the leg power of basketball athletes, even though VO_2 max and reactive agility had not been able to increase significantly. This means that the Yogyakarta Special Region basketball coaches tend to apply partial training methods. This is because there is no validity value that can be used as a guideline that is applied to interval and plyometric training, especially to increase VO_2 max, reactive agility, and power simultaneously in basketball athletes aged 13-18 years.

Content validity is carried out to ascertain whether the contents of the interval and plyometric training designs for increasing VO_2 max, reactive agility, and power simultaneously are appropriate and relevant to the training objectives. Content validity indicates content that reflects the full range of attributes studied and is usually carried out by experts [18]. Content validity estimates are obtained by thoroughly and systematically assessing each item to determine the extent to which they reflect and do not reflect the content domain [19, 20]. Important content validity is used as the first step for product design development. Content validity is often obtained through a qualitative expert assessment of the agreement of the assessors and it is also recommended to be tested quantitatively using the Aiken formula [21].

The training model can be said to be appropriate if it has a high validity value from the results of expert assessments. Research related to the differences and effects of interval, circuit, and plyometric training methods has been carried out a lot. The previous research conducted some aspects such as increasing endurance, strength, reaction, speed, agility, and explosive power. However, there is no comparative study between interval training and plyometrics to increase VO_2 max, reactive agility, and leg power in basketball athletes. For this reason, it is necessary to have research that specifically examines the validity of the content of interval and plyometric training designs on the simultaneous increase in VO_2 max, reactive agility, and power in basketball. Through appropriate research, it is hoped that we can produce a training model to be applied to basketball players aged 13-18 years.

2. Materials and Methods

This research applied content validity. Content validity is the validity that is estimated through testing the feasibility or relevance of the test content through rational analysis by a competent panel or expert judgment using the Aiken formula [22]. Formulates the Aiken's V formula to calculate the content-validity coefficient which is based on the results of an assessment by a panel of experts of n people on an item in terms of the extent to which the item represents the construct being measured. The number of research samples was 40 basketball athletes aged 13-18 years. The sampling technique used random sampling. The research subjects were 7 experts consisting of 2 academic experts and 5 professional experts.

Data collection applied the Delphi technique. In the Delphi technique, expert judgments did not have directly or face to face interaction in assessing interval and plyometric training on increases in VO_2 max, reactive agility, and leg power simultaneously in basketball. Meanwhile, input from expert judgment was then analyzed qualitatively for revision. The revised results were returned to the experts until they were completely accepted without further improvement. This research instrument used a questionnaire with a rating scale of 1 to 4, namely very relevant, relevant, less relevant, and not relevant. To add, the data analysis implemented Aiken's V formula [22]. Each aspect was calculated by content validity index with the following calculations: $V = \sum s / [n(C-1)]$. S = R-Lo, Lo = lowest score, C = highest score, and R = the score given by the assessors.

3. Results and Discussion

Furthermore, the results of calculations and analysis using Aiken's formula approach are concluded in the form of categorizing validity. The categorization of content validity refers to the validity classification proposed by Guilford (Guilford, 1956) as follows: $0,80 < rxy < 1,00$: Very high validity (very good), $0,60 < rxy < 0,80$: High validity (good), $0,40 < rxy < 0,60$: Medium validity (enough), $0,20 < rxy < 0,40$: Low validity (less), $0,00 < rxy < 0,20$: Very low validity and then $rxy < 0,00$: Invalid.

The interval and plyometric training designs are as follows:

Table 1: Practice Plyometric Program for 13-18 Years Old

Week	Meeting	Practice Program	Rest Time Between Reps and Sets	Intensity
1-2	1-4	Vertical jump 2x10 Lateral jump 2x10 Horizontal jump 1x10	Rest Reps: 50 sec Rest Sets: 180 sec	Medium
3-4	5-8	Vertical jump 1x10 Lateral jump 1x10 Horizontal jump 2x10 Jump with knee raise 4x5	Rest Reps: 50 sec Rest Sets: 180 sec	Medium
5-6	9-12	Vertical jump 1x15 Lateral jump 1x15 Horizontal jump 2x10 Jump with alternating lunges 4x5	Rest Reps: 60 sec Rest Sets: 180 sec	Medium
7-8	13-16	Vertical jump 1x10 Horizontal jump 2x10 Jump with knee raises 2x10 Forward consecutive 6x5	Rest Reps: 60 sec Rest Sets: 180 sec	Medium

Table 2: Practice Interval Program for 13-18 Years Old

Week	Meeting	Practice Program	Distance	Rest Time Between Reps. And Sets	Intensity
1-2	1-4	Sprint no drible 2x5 Speed drible right 1x5 Speed drible left 1x5	15 meters	Rest Reps: 35 sec Rest Sets: 120 sec	Medium
3-4	5-8	Sprint no drible 1x5 Speed drible right 2x5 Speed drible left 2x5	15 meters	Rest Reps: 25 sec Rest Sets: 120 sec	Medium
5-6	9-12	Catch up sprint no drible 2x5 Catch up speed drible right 2x5 Catch up speed drible left 2x5	15 meters	Rest Reps: 30 sec Rest Sets: 120 sec	Medium
7-8	13-16	Catch up speed no drible 1x5 Catch up speed drible right 2x5 Catch up speed drible left 2x5	15 meters	Rest Reps: 35 sec Rest Sets: 120 sec	

The results of the assessment of the interval and plyometric training designs for a simultaneous increase in VO_2 max, reactive agility, and leg power in basketball, are shown in Table 3 and Table 4 below.

Table 3: Raters score and Aiken test results for interval training design

Evaluation	Aspect 1		Aspect 2		Aspect 3		Aspect 4		Aspect 5		Aspect 6	
	Score	S	Score	S	Score	S	Score	S	Score	S	Score	S
A	4	3	4	3	4	3	4	3	4	3	4	3
B	3	2	3	2	3	2	3	2	3	2	3	2
C	4	3	4	3	4	3	4	3	4	3	4	3
D	4	3	4	3	4	3	4	2	3	2	4	3
E	4	3	3	2	4	3	4	3	3	2	4	3
F	4	3	4	3	4	3	4	2	4	3	4	3
G	4	3	3	2	4	3	4	3	4	3	4	3
∑ s	20		18		20		20		18		20	
V	0,952		0,857		0,952		0,952		0,857		0,952	

Notes, V is the index of expert agreement regarding the content validity of the item, s is the score given by each assessor, decreased by the lowest score in the categories which are used (s = r-lo, r = the assessor's choice category score and n is the number of experts; and c is there are many categories that experts can choose from.

Based on table 3 on aspect 1, the appropriateness of the frequency of training shows the Aiken's V coefficient value of 0,952, aspect 2 the suitability of the training volume shows the value of the Aiken's V coefficient of 0,857, aspect 3 the suitability of interval activity shows the Aiken's V coefficient value of 0,952, aspect 4 the suitability of the practice time shows the Aiken's V coefficient value of 0,952, aspect 5 suitability of rest time shows Aiken's V coefficient of 0,857, and aspect 6 the suitability of the loading shows the Aiken's V coefficient value of 0,952. Aiken's V coefficient values range from 0-1. Therefore, the minimum standard for Aiken's V coefficient for this study is 0, 76. Moreover, it can be said that all aspects are valid.

Based on Table 4 on aspect 1, the appropriateness of the frequency of training shows the Aiken's V coefficient value of 0,905, aspect 2 the appropriateness of the training volume shows the Aiken's V coefficient value of 0,857, aspect 3 the suitability of plyometric activity shows the Aiken's V coefficient value of 0,905, aspect 4 the suitability of the practice time shows the Aiken's V coefficient value of 0,952, aspect 5 suitability of rest time shows Aiken's V coefficient of 0,857, and aspect 6 the suitability of the loading shows the Aiken's V coefficient value of 0,857. Aiken's V coefficient values range from 0-1. Because the minimum standard for Aiken's V coefficient for this study is 0, 76, then it can be said that all aspects are valid. Thus, the plyometric exercise design has very good validation.

Table 4: Aiken test results for plyometric exercise designs

Evaluation	Aspect 1		Aspect 2		Aspect 3		Aspect 4		Aspect 5		Aspect 6	
	Score	S	Score	S	Score	S	Score	S	Score	S	Score	S
A	4	3	4	3	4	3	4	3	4	3	4	3
B	3	2	3	2	3	2	3	2	3	2	3	2
C	4	3	4	3	4	3	4	3	4	3	4	3
D	4	3	4	3	4	3	4	2	3	2	4	3
E	4	3	3	2	4	3	4	3	3	2	4	3
F	4	3	4	3	4	3	4	2	4	3	3	2
G	3	2	3	2	3	2	4	3	4	3	3	2
$\sum s$	19		18		19		20		18		18	
V	0,905		0,857		0,905		0,952		0,857		0,857	

Furthermore, The basic principle of basketball is to win the game by collecting as many points as possible by putting the ball into the opponent's basket and preventing the opponent from doing the same in his own basket. To be able to get value, basketball players must master basketball game techniques well, including: Dribbling, passing, shooting, pivots, lay-ups, and rebounding (Offensive & defensive) [2, 23]. In addition to good technical mastery, basketball players must be supported by excellent physical condition abilities, including: Speed, strength, power, agility, and endurance. Mastery of technical movements supported by good physical condition abilities will make it easier for basketball players to attack and defend during the game [23]. For example in order to pass an opponent when dribbling a basketball player must be able to move quickly and change direction in a short time, while when doing a defensive rebound, the basketball player must be able to react quickly in order to grab the ball faster than the opponent. For this reason, it is necessary to support the ability of good physical condition so that basketball players can perform optimally and can win every match.

Every technical movement in a basketball game must be done at high speed, changing directions, and carried out over a long period of time. This means that in basketball games, a good ability of VO_2 max, reactive agility, and power abilities are needed in order to win every match because VO_2 max, reactive agility, and power are bio motor components that are indispensable in basketball games. Athletes who have the adequate aerobic ability (VO_2 max) will be able to move with high intensity for a relatively long time and faster in recovering quickly so that they do not experience significant fatigue. Athletes who have good reactive agility abilities will act easier to perform technical movements perfectly during the match. Meanwhile, athletes who have good power will find it easier to make explosive movements. For this reason, an exercise design is needed that can be used to increase VO_2 max, reactive agility, and power simultaneously.

In order to perform optimally in basketball games, players must have good bio motor abilities, including: Reaction speed, power, and Vo_2 max. The implementation of technical movements in basketball games must be done quickly, change direction, and be carried out for a long time. For this reason, an appropriate training model is needed so that the goals and objectives of the training can be achieved in accordance with the planned training program. Training methods and models to improve the bio motor components of reaction speed, power, and Vo_2 max have been widely used in basketball, but most of the application of training models still tend to be partial. As a result, some basketball players have difficulty performing optimally and have a hard time reaching peak performance, especially for children aged 13-18 years.

In the game of basketball, children aged 13-18 years are at the stage of developing physical conditions and perfecting techniques [12, 2]. For this reason, the physical condition training design applied in the training process must be appropriate and adjusted to the needs of the technical movements required in basketball games. Based on research conducted in the Special Region of Yogyakarta, it shows that interval training design and plyometric training design can significantly improve Vo_2 max, reactive agility, and power simultaneously. Thus, interval training design and plyometric training design are one of the solutions that can be used to improve physical condition abilities in basketball players aged 13-18 years. The results also show that the interval training exercise design and plyometric exercise design have a V Aiken coefficient value above 0.80, which means that both designs have a very high validity value. Thus, the interval training exercise design and plyometric exercise design can be used or applied to basketball players aged 13-18 years, especially those with the same characteristics as the sample and where the research was conducted.

Exercise design is the product of thinking, planning, and application to the training process [24]. This means that exercise design is an instrument used to improve the quality of training [25]. An exercise design is said to be appropriate if it can lead to better changes in the training goals and objectives that have been set [26, 27]. Therefore, success in the training process is determined by the accuracy of planning, compiling and implementing a structured and systematic exercise design. Thus, exercise design must have a high level of validity in order to make a positive contribution to the training process.

The interval and plyometric training design were developed with the aim of improving the ability of VO_2 max, reactive agility, and power simultaneously in Yogyakarta Special Region basketball athletes aged 13-18 years. So far, the implementation of interval and plyometric training designs to improve VO_2 max, reactive agility, and power has been carried out separately, so that it reduces the level of efficiency and effectiveness. Through this research, it is expected to produce the right exercise design to increase VO_2 max, reactive agility, and power simultaneously for basketball athletes in Yogyakarta Special Region. Exercise design that has a high level of validity will show the accuracy and discerment of the instruments that have been compiled. It means that the interval and plyometric exercise design can be used or applied to the 13-18-year-old basketball training process that has the same characteristics [28, 29, 30].

The results showed that interval training design and plyometrics can improve the ability of VO_2 max, reactive agility, and power simultaneously for basketball athletes in Yogyakarta Special Region. In addition, based on the assessment of 7 experts, the results showed that the interval training design and plyometrics can be used to improve VO_2 max, reactive agility, and power simultaneously in basketball

athletes in the Special Region of Yogyakarta as well.To determine the accuracy and accuracy in implementing the design, it needs to be strengthened by validity testing using the Aiken Formula. The results of the validity test are expected to be used to strengthen the assumption that the interval training design and plyometric have a significant effect on increasing VO_2 max, reactive agility, and power simultaneously.

The results of the quantitative content validity test with the Aiken formula found that all items from the seven interval and plyometric training design assessors for the simultaneous increase in VO_2 max, reactive agility, and leg power in basketball showed a value of V above 0.80, where the coefficient value range Aiken's V is: V<0.8 (high validity), V 0.4<V0.8 (Medium validity), and V<0.4 (low validity). Because the minimum standard for Aiken's V coefficient for research is 0.76, it can be said that all aspects are very valid. Thus, it can be said that interval and plyometric training to increase VO_2 max, reactive agility, and power has adequate validity or high validity.

The basic principle of basketball is to win the game by collecting as many points as possible by putting the ball into the opponent's basket and preventing the opponent from doing the same in his own basket. To be able to get value, basketball players must master basketball game techniques well, including: Dribbling, passing, shooting, pivots, lay-ups, and rebounding (Offensive & defensive) [2, 23]. In addition to good technical mastery, basketball players must be supported by excellent physical condition abilities, including: Speed, strength, power, agility, and endurance. Mastery of technical movements supported by good physical condition abilities will make it easier for basketball players to attack and defend during the game [23]. For example in order to pass an opponent when dribbling a basketball player must be able to move quickly and change direction in a short time, while when doing a defensive rebound, the basketball player must be able to react quickly in order to grab the ball faster than the opponent. For this reason, it is necessary to support the ability of good physical condition so that basketball players can perform optimally and can win every match.

Every technical movement in a basketball game must be done at high speed, changing directions, and carried out over a long period of time. This means that in basketball games, a good ability of VO_2 max, reactive agility, and power abilities are needed in order to win every match because VO_2 max, reactive agility, and power are bio motor components that are indispensable in basketball games. Athletes who have the adequate aerobic ability (VO_2 max) will be able to move with high intensity for a relatively long time and faster in recovering quickly so that they do not experience significant fatigue. Athletes who have good reactive agility abilities will act easier to perform technical movements perfectly during the match. Meanwhile, athletes who have good power will find it easier to make explosive movements. For this reason, an exercise design is needed that can be used to increase VO_2 max, reactive agility, and power simultaneously.

In order to perform optimally in basketball games, players must have good bio motor abilities, including: Reaction speed, power, and Vo_2 max. The implementation of technical movements in basketball games must be done quickly, change direction, and be carried out for a long time. For this reason, an appropriate training model is needed so that the goals and objectives of the training can be achieved in accordance with the planned training program. Training methods and models to improve the bio motor components of reaction speed, power, and Vo_2 max have been widely used in basketball, but most of the application of training models still tend to be partial. As a result, some basketball players have difficulty performing optimally and have a hard time reaching peak performance, especially for children aged 13-18 years.

In the game of basketball, children aged 13-18 years are at the stage of developing physical conditions and perfecting techniques [12, 2]. For this reason, the physical condition training design applied in the training process must be appropriate and adjusted to the needs of the technical movements required in basketball games. Based on research conducted in the Special Region of Yogyakarta, it shows that interval training design and plyometric training design can significantly improve Vo_2 max, reactive agility, and power simultaneously. Thus, interval training design and plyometric training design are one of the solutions that can be used to improve physical condition abilities in basketball players aged 13-18 years. The results also show that the interval training exercise design and plyometric exercise design have a V Aiken coefficient value above 0.80, which means that both designs have a very high validity value. Thus, the interval training exercise design and plyometric exercise design can be used or applied to basketball players aged 13-18 years, especially those with the same characteristics as the sample and where the research was conducted.

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The interval and plyometric training design were developed with the aim of improving the ability of VO_2 max, reactive agility, and power simultaneously in Yogyakarta Special Region basketball athletes aged 13-18 years. So far, the implementation of interval and plyometric training designs to improve VO_2 max, reactive agility, and power has been carried out separately, so that it reduces the level of efficiency and effectiveness. Through this research, it is expected to produce the right exercise design to increase VO_2 max, reactive agility, and power simultaneously for basketball athletes in Yogyakarta Special Region. Exercise design that has a high level of validity will show the accuracy and discerment of the instruments that have been compiled. It means that the interval and plyometric exercise design can be used or applied to the 13-18 year old basketball training process that has the same characteristics [28, 29, 30].

The results showed that interval training design and plyometrics can improve the ability of VO_2 max, reactive agility, and power simultaneously for basketball athletes in Yogyakarta Special Region. In addition, based on the assessment of 7 experts, the results showed that the interval training design and plyometrics can be used to improve VO_2 max, reactive agility, and power simultaneously in basketball athletes in the Special Region of Yogyakarta as well.To determine the accuracy and accuracy in implementing the design, it needs to be strengthened by validity testing using the Aiken Formula. The results of the validity test are expected to be used to strengthen the assumption that the interval training design and plyometric have a significant

effect on increasing VO_2 max, reactive agility, and power simultaneously.

The results of the quantitative content validity test with the Aiken formula found that all items from the seven interval and plyometric training design assessors for the simultaneous increase in VO_2 max, reactive agility, and leg power in basketball showed a value of V above 0.80, where the coefficient value range Aiken's V is V<0.8 (high validity), V 0.4<V0.8 (medium validity), and V<0.4 (low validity). Because the minimum standard for Aiken's V coefficient for research is 0.76, it can be said that all aspects are very valid. Thus, it can be said that interval and plyometric training to increase VO_2 max, reactive agility, and power has adequate validity or high validity.

4. Conclusions

Based on the results and discussion, it can be concluded that the design of the interval and plyometric training program for the simultaneous improvement in VO_2 max, reactive agility, and power in basketball has sufficient content validity with Aiken. In order for the validity value to be stronger, for further research, it is suggested that a Pre-test and Post-test suggesting an intervention study next to see if training is effective be carried out on young basketball athletes. I nterval and plyometric designs can be used to increase VO_2 max, reactive agility, and power simultaneously at the age of 13-18 years, especially in basketball games. For future researchers, it is suggested that the age factor should be considered and adjusted to the characteristics of children's growth and development, especially if using interval and plyometric training designs. Thus, the dose of exercise given to children is more appropriate and does not result in over training and injury.

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