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Original article

Interrelation between variables related to the speed of pitching in Baseball

Interrelación entre variables relacionadas con la velocidad del lanzamiento en el béisbol

Inter-relação entre variáveis relacionadas à velocidade do arremesso no beisebol

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ABSTRACT

In Baseball, the studies carried out concerning the types of motor capacity connections, the structure of the sporting fitness, and the interrelation of variables that have influence on the speed of pitching are limited. Facing with the question of how and how much the different motor capacities and their manifestations influence the pitching speed in Baseball, the research objective was defined: to compare the level of interrelation among

some physical variables and the speed of pitching in a sample of players and a sample of non-players. Measurement was used as an empirical method for the application of the tests of 50 meters speed with a high start, long jump without a run of impulse, shot puts, Sit-ups, and the Pitching Speed. The sample has 36 subjects, divided in two groups, A and B with 18 members each. Pearson and Determination coefficients were applied to establish the level of statistical interrelation between the variables. In group A, concerning the sample of players, strong and medium correlations were obtained in two cases respectively, reporting significant levels of interdependence. However, in group B, where non-practitioners were located, there was not a significant interrelation of the variables with the speed of pitching. The systematic practice of physical exercises in a planned way seems to have importance in the structure that the capacities adopt and on the influence that they have on each other.

Keywords: Baseball; Capacities; Pitching; Speed.

RESUMEN

En el béisbol, los estudios realizados en relación con las conexiones de las capacidades motoras, la estructura de la forma física y la interrelación de variables que influyen en la velocidad del lanzamiento son limitados. Ante la interrogante de cómo y cuánto influyen las diferentes capacidades motoras y sus manifestaciones en la velocidad del lanzamiento en el béisbol, se definió como objetivo de la investigación: comparar el nivel de interrelación de varias variables físicas con la velocidad del lanzamiento en una muestra de jugadores y una de no jugadores de béisbol. Se utilizó la medición como método empírico para la aplicación de las pruebas de velocidad 50 metros, con arrancada alta, salto de longitud sin carrera de impulso, impulsión de la bala, elevaciones del tronco en el suelo y velocidad del lanzamiento. La muestra tuvo un total de 36 sujetos, divididos en dos grupos, A y B, con 18 miembros cada uno. Se aplicaron los coeficientes de Pearson y de Determinación para establecer el nivel de interrelación estadística entre las variables. En el grupo A, concerniente a la muestra de jugadores, se obtuvieron correlaciones fuertes y medias en dos casos respectivamente, reportando niveles significativos de interdependencia. Sin embargo, en el grupo B, donde se ubicaban los no practicantes, en ningún caso se visualizó interrelación significativa de las variables con la velocidad del lanzamiento. La práctica sistemática de ejercicios físicos de forma planificada demostró tener importancia en la estructura que adoptan las capacidades y cómo influyen mutuamente.

Palabras clave: Béisbol; Capacidades; Lanzamiento; Velocidad.

RESUMO

No beisebol, os estudos realizados em relação às conexões das capacidades motoras, a estrutura da forma física e a inter-relação das variáveis que influenciam a velocidade de arremesso são limitados. Diante da questão de como e quanto as diferentes capacidades motoras e suas manifestações influenciam a velocidade de arremesso no beisebol, o objetivo da pesquisa foi definido como: comparar o nível de inter-relação de várias variáveis físicas com a velocidade de arremesso em uma amostra de jogadores de beisebol e uma amostra de jogadores que não jogam beisebol. A medição foi utilizada como um método empírico para a aplicação dos testes de velocidade 50 metros, com partida em altura, salto em comprimento sem impulso de corrida, tiro de impulso colocado, elevação do tronco no chão e velocidade de arremesso. A amostra tinha um total de 36 sujeitos, divididos em dois grupos, A e B, com 18 membros cada um. Os

coeficientes de Pearson e os coeficientes de determinação foram aplicados para estabelecer o nível de inter-relação estatística entre as variáveis. No grupo A, relativo à amostra de jogadores, foram obtidas correlações fortes e médias em dois casos, respectivamente, relatando níveis significativos de interdependência. Entretanto, no grupo B, onde os não-jogadores estavam localizados, em nenhum caso foi visualizada uma inter-relação significativa das variáveis com a velocidade de arremesso. A prática sistemática de exercícios físicos de forma planejada provou ser importante na estrutura que as capacidades adotam e como elas influenciam umas às outras.

Palavras-chave: Beisebol; Capacidades; Batedor; Velocidade**.**

INTRODUCTION

Modern sport is characterized by the achievement of new records and scores that, in previous years, seemed impossible to achieve. The use of new technologies and modern training methods favors a substantial increase in results in almost all sports. At the same time, the high cost of the equipment necessary for the practice of some sports increases the gap between developed countries and underdeveloped nations (Pérez *et al.,* 2016). These advances are also reflected in the ways used for the planning and control of training loads. Traditional periodization systems give way to the emergence of new systems such as concentrated loads. Coaches and athletes reach a state of sporting fitness more frequently in the same season. The starting point is the conception that this state is qualitatively and quantitatively superior to the previous state.

The systematic practice of a sporting discipline is distinguished by the fact that it causes a change in the individual's environment. A physical activity regime is introduced to which the body was not previously adapted. Faced with this new stimulus, the organism tries to adapt with the whole complex of systems, including the central nervous system and the muscular system. The interaction between the various responses of these systems established the effectiveness of the body's response as a whole.

Since the mid-50s of the last century, the Soviet scientist and biochemist Yakovlev described the cycle of super compensation after a training session, the relationship between load and rest has been at the center of attention of trainers (Vb, 2010). The ideal method is used to develop a capacity; proper load and correct recovery time are of utmost importance in high performance. In addition to that, developing the manifestation of each capacity at the appropriate time of preparation is extremely important.

In one phase of the preparation, the training of one manifestation of a physical capacity may be essential, however, at another time in the same macrocycle, its exercise may be counterproductive. For example, during the preparatory period, many sports seek to develop muscular hypertrophy as a basis for the future development of other expressions of strength such as explosive strength. But close to competition, this type of loading can have adverse effects on achieving sporting fitness.

A study developed by Verkhoshansky and Siff (2019) (Figure 1) shows that there was no direct and significant connection between the height achieved in a vertical jump (h) and the absolute leg strength (Fo). However, the absolute strength determines the magnitude of the maximum take-off strength (Fmax in Spanish) which, in turn, influences the magnitude of the impulse (F.t) of the take-off and ultimately the height of the jump.

Considering this result, a sport, where explosive leg strength plays a major role in competitive performance, should not be training maximal leg strength close to the competition. It should focus on methods and exercises that allow the transfer of previously achieved maximal strength.

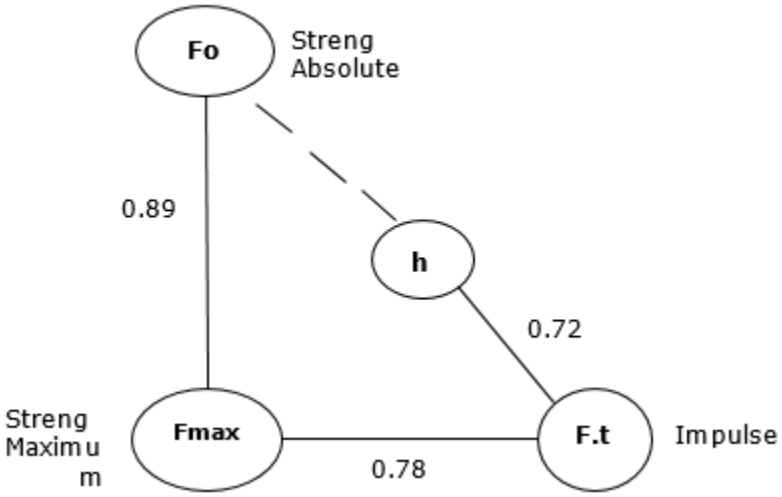

Fig. 1. - Practical model of an indirect interrelation between motor skills. (Verkhoshansky and Siff, 2019)

Several studies have been carried out in relation to the different types of connections between motor skills. Verkhoshansky and Siff (2019) make mention of several researches that have been developed on this topic and from their analysis, they offer the most complete classification of connections between capacities

- Partial: direct interaction between two capacities
- General: interaction between two motor capacities including the influence of the remaining capacities
- Essential: without them, effective sporting actions are impossible.
- Non-essential: false connections that contribute to a worsening of physical fitness
- Positive and negative: in the relationship between capacities, when a capacity improves the situation of others, it is a positive connection, and when it worsens it, it is negative.
- Direct: they are characterized by the relationship between two capacities and can express any of the types of connections described above.
- Indirect: these are relationships between two capacities that are related through a third; in them, there is a direct and essential connection between two capacities. This structure is the most characteristic of the physical fitness.

When and how to train motor qualities has been the subject of study by researchers and coaches of various sports. For example, Carreño and de Armas (2001) developed a study to determine the order of importance of motor capacities in the optimal state of physical preparation in wrestlers aged 12 to 15 years old. Also in Greco-Roman wrestling appears the work of Kuznetsov and Mubarakzyano (2017) where the relationship between functional and technical-tactical indicators was analyzed and the level of influence that these have on the willingness to sports performance is determined.

In sports, where the aim is to print speed to an object by throwing it, there have also been precedents, for example, the research conducted by Borges *et al.,* (2017) where they study the relationship between anthropometric parameters and maximum grip with the throwing speed in water polo players. Also, the one carried out by Portus et *al., (*2000) in which the influence of different factors on the throwing speed in Cricket was analyzed.

In baseball, it is also very important to be able to throw the ball at high speed. Both control and speed are essential for a pitcher; training is generally aimed at raising the levels that *pitchers* possess in these qualities. Possessing a good line drive doesn't guarantee success, but it certainly helps. A line that travels at a speed of 90 miles per hour travels the distance from the *box* to *home* in 0.42 seconds, leaving the batter a very short reaction time margin (Pérez, 2013).

There are several qualities that should characterize a successful pitcher, such as mastery of the technical elements that allow fluidity in the movements with mechanical efficiency, the development of physical capacities such as strength, flexibility, endurance and coordination, in addition, the development of psychological preparation and, within it, aspects such as concentration of attention, mental tolerance and perception of distance, etc. Medical variables such as somatotype and body composition characteristics. All these variables will influence the manifestation of two very important aspects for a thrower: the speed and control of his throws (Pérez and Castro, 2019).

Pitching speed is a factor that talent scouts use as a benchmark when identifying children and young people with prospects for the practice of Baseball. In the opinion of most, control is something that develops with systematic training; but speed has a high genetic component and is more difficult to improve, although, of course, it also improves. It is in the training sessions where the fitness is built that allows to achieve a high state of training and also where it is worked to try to maintain it as long as possible. The loads administered to the players will allow a growth of the qualities and these, in turn, will allow an improvement in sports performance that will result in more speed and control (Pérez *et al.,* 2020).

In Cuba, studies have been conducted in the area of pitching, several of them seeking to achieve an increase in pitching speed. In recent years, the methodology for explosive strength training in baseball pitchers, developed by Cumbrera *et al.,* (2014), stands out. This methodology, after experimentation, achieved an improvement between the beginning of the general preparation and the beginning of the competition in 1.5 miles per hour. In some isolated cases, there was an increase in speed between 2 and 3 miles and in certain athletes there was no increase in speed.

This research was developed using an experiment with minimal control, the results were not contrasted with a control group. When evaluating the result, it should be taken into account that, although it was positive, it did not represent a great increase in the speed of the throws. In fact, some athletes did not increase their speed after all the

preparation. Perhaps, if together with the unobjectionable contribution of the thesis, the researchers had had a structural model that described the physical fitness of the Baseball pitcher and the type of existing connections between his capacities, this would have allowed them to know, with more precision, when to train each manifestation of the capacities and the growth in speed would have been superior.

In baseball, the studies carried out in relation to the types of motor capacities connections, the structure of physical fitness and the interrelation of variables that influence pitching speed are limited. In this regard, only the research entitled *"Introduction to the study of variables related to pitching speed in baseball"* has been found (Pérez *et al.,* 2020). Given the question of how and how much influence the different motor capacities and their manifestations in the speed of pitching in baseball, it was defined as the objective of the research: to compare the level of interrelation of several physical variables with the speed of pitching in a sample of players and a sample of non-players of baseball.

MATERIALS AND METHODS

Based on the exploratory and correlational characteristics of the research, due to the fact that it examines a little-studied topic in which the aim is to establish an association between several variables, it was decided to use a non-probabilistic sample. Thirty-six subjects were selected, divided into two groups, with 18 members each, based on the following criteria:

Group A:

- That all were members of the Baseball team category 15-16 years of the Eide (Sport Initiation School) "Luis Augusto Turcios Lima" of Matanzas.

Group B:

- That all of them were students of Physical Culture, which allows to have a sample that is active in the practice of physical exercise.
- That they have received the subject Baseball, which guarantees a knowledge and mastery of the basic motor skills to throw the ball.
- That they were all male.
- From an initial sample of 34 students of 3rd and 4th years of the Physical Culture degree at the University of Matanzas, the 18 best in the throwing speed test were selected. In this way, both groups would have the same size.

The use of the measurement method allowed the collection of the data in the different tests applied to the members of the sample. For the selection of the physical performance tests, it was decided to use four common *tests* to which the members of the sample were accustomed and which, in addition, are frequently used by baseball coaches. Both groups underwent the same tests with a difference in the abdominal strength test.

Before applying the tests, a general and special warm-up was performed, focused on the muscular planes that would play a leading role in the tests.

To apply the tests, five stations were created and the order in which the subjects executed them was:

- Speed 50 meters with high start:

Two repetitions were performed and the time of the fastest one was taken.

- Throw speed:

A specific warm-up was performed beforehand, with the use of gloves and balls, which stopped when each individual considered they were ready. The ball was thrown from the front position and without wind-up. Five throws were made and the one with the highest speed was taken as a reference.

- Long jump without an impulse run.

Two jumps were made and the one with the longest length was taken.

- Shot put.

The throw was executed and both hands were used simultaneously. Two repetitions were performed and the result of greater length was taken.

- Sit-ups on the floor.

In the case of this test, there was a difference between both groups. The sample of university students was counted the highest number of sit-ups correctly executed in 30 seconds. The group of athletes was asked to perform 30 repetitions of trunk raises in the shortest time possible.

In the application of the tests, the following factors were taken into account. They were carried out in the morning section, both groups did it in the schedule of 8:30 - 9:30 am, on different days. On Tuesday, the group of students of the Bachelor's Degree in Physical Culture and on Thursday of the same week, the athletes of the Provincial Eide of Matanzas. The subjects performed the tests with appropriate clothing and footwear. For a better organization and to be able to perform the tests without loss of time, the groups met in advance and were informed that they would be part of an research so they had to do their best.

The instruments used were:

1. A "Medid" tape measure.
2. Chronometers brand Medallist of Chinese manufacture model JS-320.
3. A Bushnell brand radar gun to measure the speed of the launch.
4. Official shot put implement with a weight of 7.26 kilograms.
5. SPSS version 22 software for data processing.

Statistical techniques and procedures used:

To determine the statistical interrelation between the test results, Pearson's linear correlation coefficient (r) was used because the variables studied are continuous in

nature. The coefficient of determination (D) was also used to strengthen the result obtained in the level of tightness of the interrelation and to determine the percentage of variation of one coefficient with respect to another.

RESULTS AND DISCUSSION

Analysis of the interrelation between the variables measured with throwing speed in both groups

The first variables analyzed were the speed of displacement in the 50-meter race, with the speed of the pitch (Table 1). Short distance sprinting is an exercise widely used by pitching coaches. It is considered important for competitive pitching performance. One of the bases is the use of anaerobic sources of energy, as it happens in the action of pitching.

Repeated loads of speed runs are used very frequently, both in the preseason and during the development of the competition. In tournaments such as the National Series or youth and cadet championships, which are played several days a week for several months, it is common for starting pitchers, the day before they are scheduled to work in the rotation, to train by doing several repetitions of 50-meter sprints (Pérez *et al.,* 2020).

The correlation between the variables evaluated in group A is statistically strong and negative, which translates into a high and inversely proportional mutual influence. The negative result in its interpretation becomes positive due to the difference in the units of measurement used. As the time recorded in the run decreases, one is faster and, in the case of throwing, one will be faster as the miles recorded increase. This relationship has a highly significant value and from the point of view of the coefficient of Determination (D) the mutual influence between both variables can be explained by 55 %. With these values, it seems that the 50-meter sprints justify their importance as contributors to throwing speed performance.

When analyzing the interrelation reached by the variables in group B, a different result is shown. The statistical correlation qualifies as very weak, lacking statistical significance and the relationship between both variables can be explained only for an insignificant 4 %, devoid of importance. These values show a null influence of the athletic performance in the 50 m sprint on the throwing speed.

The most interesting aspect of this first comparison is the difference in results between the groups. The levels of mutual influence report values very distant from each other. When analyzing the results obtained by groups A and B, marked differences in the correlation of the variables are observed. Both groups performed the tests under the same conditions, however, the values of interdependence are widely different. The direct and partial connection that is analyzed in the case of group B does not justify the development of the displacement speed with the aim of contributing to the throwing speed. On the contrary, in group A, this relationship appears to have a significant influence as it shows what appears to be a direct, essential and positive connection (Table 1).

Table 1.- Interrelation between the variables speed in the 50m run with high start and throwing speed

Variables	Correlation	Sig.	Det. Coef.
Throw Athletes-Speed Athletes (A)	-0.739	.000	55 %
Throw Student-Speed Student (B)	-0.194	.440	4 %

The second variable analyzed in its relationship to pitching speed was the long jump without an impulse run (Table 2). Leg strength is considered very important by *pitching* coaches. Strong legs ensure the base of support and are also the first link in the chain of energy transfer. In this case, the strength manifestation analyzed is explosive strength. It was decided to use this test and not the sergeant's jump, because the longitudinal jump is more related to the explosive forward movement that the legs make when a ball is thrown, not so in the vertical jump, which is more typical of other sports actions.

The statistical correlation between both variables in the group of athletes is statistically strong and highly significant. The interrelation is positive and the mutual influence between both variables can be explained by 54 % from the coefficient of determination. That is, according to these values, to the same extent that explosive strength of the lower body is gained, in a partial way, it will be contributing to the throwing velocity. From these data, it seems that there is a direct, essential and positive connection between the measured manifestation of both capacities.

The case is totally contrary to the results of group B, where the values show a null relationship between the variables under analysis. Pearson's coefficient reports a value of 0.039, which is also negative. Analyzing the values of table 2, it could be concluded in a partial and preliminary way that the explosive strength of the lower body in non-athletes does not contribute to the speed with which the ball is thrown. In this second comparison, as in the first one, the variables studied have different behaviors according to the group. In the athletes who train in a systematic and organized way, a high interrelation between the variables is evidenced, with connections that are presented as positive. On the contrary, in the non-athletes, where there does not seem to be any type of relationship.

In this second comparison, as in the first, the variables studied have different behaviors depending on the group. In athletes who train in a systematic and organized way, there is a high interrelation between the variables, with connections that are presented as positive. Quite the contrary, in non-athletes, where there does not seem to be any type of relationship (Table 2).

This result coincides with the opinion of Vb (2010) when he states that the gains obtained in explosive strength in athletes can be explained as part of the cumulative effect of long duration. This is something typical of high performance and that the members of group B do not have because they are not linked to systematic practice.

Table 2. - Interrelation between the variables long jump without impulse run and throwing speed

Variables	Correlation	Sig.	Det. Coef.
Throw Athlete-Jump Athletes(A)	-0.576	.012	33 %
Throw stud Jump (B)	0.025	.922	0 %

The third variable compared to throwing speed was the abdominal strength test (Table 3). As explained above, in the case of this test there was a difference between the two groups. The sample of university students was counted the highest number of sit-ups correctly executed in 30 seconds. The group of athletes was asked to perform 30 repetitions of trunk raises in the shortest time possible.

The tests applied to both groups are part of a larger study in sample and time length. The data were collected before making the decision to compare the results. However, although it does not comply with an exact standardization, it was decided to maintain the comparison between both tests taking into account the preliminary, exploratory and introductory research characteristic of the study. In addition, population comparison statisticians are not used; instead, both correlations are analyzed in a comparative manner.

The exercise mainly involves the greatest rectus abdominis, the anterior rectus abdominis, the obliquus abdominis and tensor fascia latae. This test is widely used among coaches to evaluate the abdominal strength of athletes. The abdominal area is very important for the thrower, it is the center of the body in charge of the balance together with the muscles of the lower back such as the latissimus dorsi, rhomboids and the latissimus dorsi aponeurosis (Pérez *et al.*, 2020).

In the first group, when applying Pearson's test, a correlation level that qualifies as medium and a statistical significance of less than 0.05 was found. When taking the interrelation to percent, a 33 % of interdependence in the mutual influence between the variables is established. The correlation value appears as negative, therefore the relationship between the variables, although strong, is inversely proportional. As happened with the speed test, this result is logical and positive, given that the athletes show more strength to the same extent that they finish the *test* in less time. From these data, the described connection can also be qualified as positive and essential.

In the case of the group of Physical Culture students, the same pattern of the previous tests is repeated. The result shown in table 3 does not evidence any influence of the abdominal strength measured in the flekxions *test* on the floor and the throwing speed. While in one group it seems to be a quality of importance, showing a possible direct and essential connection, in the other it lacks value and seems to have no influence, at least directly (Table 3).

Table 3. - Interrelation between the variables Trunk elevations on the ground and throwing speed

Variables	Correlation	Sig.	Det. Coef.
Athlete throw-Abd Atletas (A)	-0.576	.012	33 %
Student throw-Abd Alum (B)	0.025	.922	0 %

The last of the variables analyzed in its relationship with the speed of the throw was the Shot put (Table 4). With this test, the goal was to obtain an estimate of the explosive strength of the upper body and to see how it was related to the power that the ball had when throwing the ball. Although the implement used in the test is heavier than the baseball and it was thrown using both hands, it was presumed to obtain an important correlation due to the similarity of the muscular contraction, in time, substrate and muscles involved.

In the latter case, the same pattern was maintained as in the previous comparisons. When analyzing the values obtained in group A, it is shown that Pearson's coefficient illustrates a medium and very significant mathematical correlation, with a percentage of mutual influence between both variables of 39 %, which is an appreciable value. Therefore, the values of explosive strength obtained in the test of impulsion of the bullet have importance for the speed that the ball is thrown, which seems to be a direct, essential and positive connection.

However, this same result was not recorded in group B. Although the correlation coefficient obtained a higher value than in the three previous tests, it still does not offer a significant result. This interrelation only qualifies as weak and can be explained by a tiny 6 %. This value, which, when analyzed in depth, lacks significance (Table 4).

Table 4.- Interrelation between the variables shot put and speed of the throw

Variables	Correlation	Sig.	Det. Coef.
Throw Athletes - Shot put Athletes (A)	0.624	.006	39 %
Throw Student- Shot put Student (B)	0.247	.324	6 %

The difference in the results obtained when analyzing the interrelation between this test of strength test with throwing velocity agrees with what was raised by Verkhoshansky and Siff (2019), when they argue that one should be cautious and not generalize to high performance the results obtained in people with low sports qualification.

After obtaining all the values, the structural model of the relationship between the measured variables, based on the percentage of variation in the mutual influence of one coefficient with respect to another, was represented as illustrated in figure 2 (Figure 2).

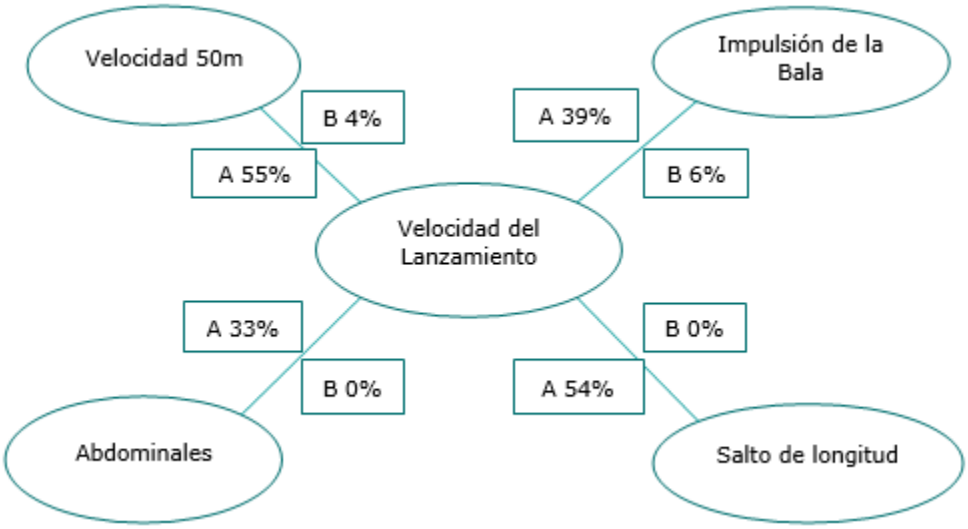

Fig. 2. - Relational structure of the variables measured with the throwing speed in both groups, from the correlation coefficient expressed in percentage

When analyzing the values obtained in the four tests, marked differences were found in the results of both groups. In group A, concerning the sample of players, strong and medium correlations were obtained in two cases respectively, and significant levels of interdependence were reported. However, in group B, where the non-practitioners were located, in no case was a significant interrelation of the variables with throwing velocity visualized; this result raises new dilemmas and new hypotheses.

It is possible that the characteristic training of the baseball player, which habituates the joints and the organism as a whole to the specific activity of throwing, influences the relationship between the capacities. The sample of non-practitioners masters the technical elements of the throwing action, but they do not train in a systematic and organized way. It seems, then, that the systematic practice of physical exercises in a planned way has importance in the structure adopted by the capacities and how they influence each other. Coinciding with the criterion of Verkhoshansky and Siff (2019) when they propose that the interdependence of motor abilities changes qualitatively and quantitatively with the improvement of sport mastery.

Another interesting element that was not homogeneous among the samples is age. Undoubtedly, this variable could influence a different result and it is interesting to be evaluated in further studies.

REFERENCES

Carreño, J. E., y de Armas, R. (2001) Orden en importancia de las capacidades motoras (fuerza, velocidad, resistencia y flexibilidad) en el estado óptimo de la preparación física en luchadores de 12 a 15 años de edad. *Efdeportes*, Buenos Aires, 7(34). https://www.efdeportes.com/efd34b/fuerza.htm

Hernández, P. J. B., Lara, E. R., & Iturriaga, F. M. A. (2017). Relación entre parámetros antropométricos, agarre máximo y velocidad de lanzamiento en jugadores jóvenes de waterpolo. *Retos: nuevas tendencias en educación física, deporte y recreación*, *31*, 212-218. https://dialnet.unirioja.es/servlet/articulo?codigo=5841374

Kuznetsov, A. S., & Mubarakzyanov, R. B. (2017). The indices interconnection of Greco-Roman style wrestlers' functional and technical-tactical readiness. *The Russian Journal of Physical Education and Sport (Pedagogico-Pshycological and Medico-Biological Problems of Physical Culture and Sports)*, *12*(4 (eng)), Article 4 (eng). https://cyberleninka.ru/article/n/the-indices-interconnection-of-greco-roman-style-wrestlers-functional-and-technical-tactical-readiness

Martínez, C. I. P., & Puentes, G. C. (2019). *Variables consideradas importantes por su influencia en la velocidad del lanzador*. http://monografias.umcc.cu/monos/2019/FCF/mo19150.pdf

Pérez, I., Alfonso, J. J., Sithole, F., Utaumire, Y., Masocha, V., & Quintana Díaz, A. (2016). Talents identification project for sports in Zimbabwe: Analysis of preliminary results. *International Journal of Arts & Sciences*, *9*(4). http://www.universitypublications.net/ijas/0904/html/R6ME179.xml

Pérez, I., Martínez, M., Quintana, A. (2020). Introducción al estudio de variables relacionadas con la velocidad del lanzamiento en el béisbol. *Podium. Revista de Ciencia y Tecnología en la Cultura Física*, *15*(1), 84-98. http://scielo.sld.cu/scielo.php?script=sci_abstract&pid=S1996-24522020000100084&lng=es&nrm=iso&tlng=es

Pérez, I. (2013). *La evaluación del rendimiento competitivo en el béisbol. Vías para su correcta ejecución.* Editorial Académica Española. https://www.worldcat.org/title/evaluacion-del-rendimiento-competitivo-en-el-beisbol-vias-para-su-correcta-ejecucion/oclc/863896522

Portus, M. R., Sinclair, P. J., Burke, S. T., Moore, D. J., &Farhart, P. J. (2000). Cricket fast bowling performance and technique and the influence of selected physical factors during an 8-over spell. *Journal of Sports Sciences*, *18*(12), 999-1011. https://doi.org/10.1080/026404100446801

Sánchez, D. C.-S. C., Suárez, I. R., & Nueva, G. N. (2014). Metodología para el entrenamiento de fuerza explosiva en lanzadores de Béisbol. *Revista científica Olimpia*, *11*(36), 13-29. https://revistas.udg.co.cu/index.php/olimpia/article/view/1385

Vb, I. (2010, enero 3). *New horizons for the methodology and physiology of training periodization*. Sports Medicine (Auckland, N.Z.); Sports Med. https://doi.org/10.2165/11319770-000000000-00000

Verkhoshansky, Y., & Siff, M. C. (2019). *Super entrenamiento*. Paidotribo. http://www.paidotribo.com/entrenamiento-deportivo/497-superentrenamiento.html

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The authors have participated in the writing of the work and analysis of the documents.